

ATOLL RESEARCH BULLETIN

72. *Report on Tarawa Atoll, Gilbert Islands*

by Edwin Doran, Jr.

73. *Some aspects of Agriculture on Tarawa Atoll, Gilbert Islands*

by R. R. Mason

74. *Birds of the Gilbert and Ellice Islands Colony*

by Peter Child



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THE PACIFIC SCIENCE BOARD

National Academy of Sciences—National Research Council

Washington, D. C., U.S.A.

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ACKNOWLEDGMENT

It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note, historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs during the past thirteen years.

The preparation and issuance of the Atoll Research Bulletin is assisted by funds from Contract N7onr-2300(12).

Bulletin No. 72, Report on Tarawa, was originally duplicated by the U. S. Navy for limited internal distribution. In order to make this information more widely available to those interested in Pacific Atolls the Navy has considerably made the report available for distribution as an Atoll Research Bulletin.

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
PHYSICAL DESCRIPTION	1
Location and Size	1
Topography	1
Hydrography	9
Climate	11
Biota	11
OWNERSHIP AND POLITICAL STABILITY	12
POPULATION AND CULTURAL ATTITUDES	15
LAND USE AND OWNERSHIP	15
FACILITIES AVAILABLE	24
Transportation	24
Sea	24
Air	36
Land	36
Meteorology	42
Communications	42
Storage	42
Utilities	47
Water Supply	47
Electric Power Supply	47
Sewage and Waste Disposal	48
Maintenance Facilities	48
Fire Protection	48
Police Protection	48
Housekeeping Facilities and Personal Services	49
Quarters and Food Supply	49
Medical and Dental Care	49
Laundry and Cleaning Services	49
Religion	53
Education	53
Recreation	53
Construction	53
SELECTED BIBLIOGRAPHY	53
APPENDIXES	
Appendix A. Vegetation of Gilbert Islands	A-1
Appendix B. Key Personnel of Gilbert and Ellice Islands Government	B-1
Appendix C. Population of Gilbert and Ellice Islands Colony	C-1

TABLE OF CONTENTS (Cont'd)

Page

APPENDIXES (Cont'd)

Appendix D. Some Avoidances to Be Observed in Relations With Natives	D-1
Appendix E. Communications in Gilbert and Ellice Islands Colony	E-1

ILLUSTRATIONS

Figure 1. Map of Tarawa Atoll	3
Figure 2. Schematic Constitution of an Atoll	5
Figure 3. Aerial View of Islet Between Bairiki and Nanikai in Tarawa Atoll at Low Tide When Passage Between Islands Is Traversable by Motor Vehicles	6
Figure 4. Typical Conspicuous Features of an Atoll and Its Peripheral Reef	7
Figure 5. Record of Tidal Level in Betio Harbor Basin for Period of 3 to 7 March 1958	10
Figure 6. Idealized Section of Ghyben-Herzberg (Fresh Water) Lens in an Oceanic Island	11
Figure 7. Physiognomic and Economic Cross-Section of a Typical Island in Tarawa Atoll	13
Figure 8. Secretariat for Gilbert and Ellice Islands Colony (Headquarters of Resident Commissioner) at Bairiki on Tarawa Atoll	14
Figure 9. Map of Betio Area on Tarawa Atoll	17
Figure 10. Map of Bairiki Area on Tarawa Atoll	19
Figure 11. Map of Bikenibeu Area on Tarawa Atoll	21
Figure 12. Typical Village on Island in Tarawa Atoll	23
Figure 13. Map of Bonriki Area on Tarawa Atoll	25
Figure 14. Aerial View of Betio Harbor (Looking Southeast)	27
Figure 15. Map of Betio Harbor	29
Figure 16. Boatyard and Ways Operated at Betio by the Wholesale Society	31
Figure 17. Boat Dock at Bairiki, With Launches Alongside and Dragline Working on Harbor Construction in Background	32
Figure 18. Map of Bairiki Harbor	33
Figure 19. Unused Mole Near West End of Bonriki Airstrip (Looking Inland From Outer End of Mole in Temaiku Bight)	35
Figure 20. Interisland Transport Ships Operated by Gilbert and Ellice Islands Colony (From Left to Right: Nareau, Te Matapula, and Ninikoria)	35
Figure 21. Aerial View of Bonriki Airfield	37
Figure 22. Surface of Runway at Bonriki Airfield (Looking Eastward)	37
Figure 23. Central Portion of Runway at Bonriki Airfield (Looking Northward)	38
Figure 24. West End of Runway at Bonriki Airfield (Looking Northward)	38
Figure 25. Slightly Wider Area at West End of Runway at Bonriki Airfield (Looking Southeast) (Note Truck With Fire Extinguisher at Extreme Left)	39
Figure 26. Map of Seaplane Landing Area North of Bairiki and Nanikai Islands Used by Royal New Zealand Air Force	40
Figure 27. Land Rover in Passage Between Islands at Low Tide	41
Figure 28. Map of U. S. Meteorological Station at Betio	43

TABLE OF CONTENTS (Cont'd)

	Page
ILLUSTRATIONS (Cont'd)	
Figure 29. Aerial View of Meteorological Station at Betio	44
Figure 30. Buildings in Meteorological Station at Betio	44
Figure 31. Transmitter Building at Betio	45
Figure 32. Nissen Building Used as Warehouse Near Dock at Bairiki	46
Figure 33. Open Storage Area for Petroleum Products at Betio	46
Figure 34. Grade D Government Housing Occupied by Gilbertese Couple in Foreground	50
Figure 35. Royal New Zealand Air Force Quarters at Bairiki (Quarters for Enlisted Men in Center, With Officers' Quarters at Extreme Right and Cook House at Extreme Left)	50
Figure 36. Map of Royal New Zealand Air Force Facility at Bairiki	51
Figure 37. King George V School at Bikenibeu (Assembly Hall at Right and Administration Building at Left)	52

INTRODUCTION

The author visited Tarawa Atoll, in the Gilbert and Ellice Islands Colony of the United Kingdom, from 22 to 30 August 1959 to amplify information available in the literature and to acquire firsthand and current knowledge of conditions and facilities on that atoll. This visit is only a small part of a program of collecting basic data about various parts of the Pacific Ocean which the U. S. Navy may use in its long term planning. The type of specific information which is of interest and utility to the Navy may also be of interest to the broader audience to which this report is disseminated.

Acknowledgment must be made here of the great assistance provided the author by the British authorities on Tarawa. Mr. Roy Davies, Acting Resident Commissioner, and his entire staff were most cooperative, and it was only through this helpfulness in supplying data and maps that accumulation of a considerable amount of information was possible in such a short time.

PHYSICAL DESCRIPTION

Location and Size

Tarawa is located in the Central Gilbert Islands, about 80 nautical miles north of the equator, at latitude $1^{\circ}21' N$ and longitude $172^{\circ}56' E$ (the coordinates of Betio Island, near the southwest corner of the atoll). Some 500 nautical miles separate Tarawa from Kwajalein, northwestward in the Marshall Islands, and Tarawa Atoll lies 650 nautical miles west of Howland Island and 235 nautical miles northeast of Ocean Island. Far to the northeast are Johnston Island (1,400 nautical miles) and Honolulu (2,100 nautical miles). Other atolls of the Gilbert chain lie in close proximity, both southeast and northwest of Tarawa.

Tarawa Atoll approximates the shape of a right triangle with an east-west base some 15 nautical miles long, a northwest-southeast hypotenuse about 21 nautical miles long, and a north-south open side on the west bordered by reefs and coral heads rather than the islets which form the other two sides (figure 1). The Gilbertese islanders recognize the shape as resembling that of a typical lateen canoe sail, the upper yard of which is called Te Inaieta, the lower yard of which is called Te Inainano, and the tack of which (southeast corner of the atoll) is called Te Win Ei.

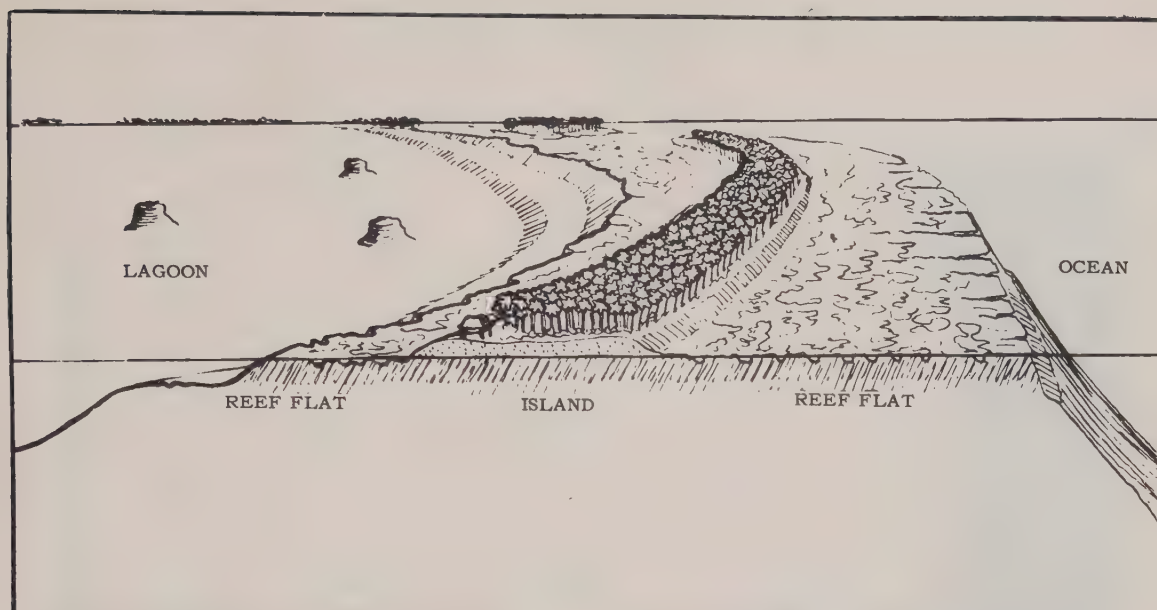
Although the circumference of the atoll is some 58 statute miles and the lagoon area is approximately 145 square statute miles, the total land area is estimated at only 7.7 square statute miles. The sea and lagoon are close together and often visible simultaneously from any location on an islet.

Topography

Tarawa is a typical Pacific atoll formed by a narrow strip of reef and islets surrounding a central lagoon (figure 2). Because of the general trend of wind and waves from easterly directions, the reef and land on this side are somewhat higher than on the leeward side, but in no case do elevations extend more than a few feet above sea level. The islets are narrow and occasionally sinuous, sometimes extending for miles in length but with widths measured in hundreds of yards. Channels separating islets are often bare at low tide, at which time motor vehicles can be driven



Figure 1. Map of Tarawa Atoll.



-- Taken from Atoll Research Bulletin No. 59.

Figure 2. Schematic Constitution of an Atoll.

around much of the atoll (figure 3). Bordering the land on both seaward and lagoon sides are continuous expanses of fringing reef, bare at low tide and covered with shallow water at high tide. These Tarawa reefs are often 400 to 700 yards wide on both the inner and outer sides of islands.

It should be noted that no type of rock other than limestone is exposed in the Gilbert Islands. The form of the rock may vary, however, from solid skeletons of corals cemented with various lime-secreting algae into a solid limestone platform, to sands and gravels created by erosion, comminution, and subsequent deposition of fragments of corals and algae.

Although hills are completely absent and maximum elevations above sea level are on the order of 20 feet, there is nevertheless a certain irregularity in atoll terrain (figure 4). Near the water on the ocean side, there typically is found a beach ridge, with steeper slopes toward the sea and more gentle declivities inland toward the center of the island. Elevations in the interior may be as little as 2 to 5 feet, from which a gentle slope again rises to a somewhat higher crest in the vicinity of the lagoon beach. Gradients on the lagoon side are gentle, and the slight elevation above the interior of the island is hardly noticeable. Even the slope down to the edge of the water, the inner side of the lagoon fringing reef, is quite gentle.

On the ocean sides of islands, beaches are moderately steep and are formed of fairly coarse gravel-sized fragments of corals thrown up by the waves. On the lagoon sides, beach materials are finer grained, often approaching a powdery sand in consistency. Where little wave action is found, as in Temaiku Bight within the southeast angle of the atoll, the sediments that accumulate are fine grained and form extensive flats of light-colored mud.

The reef flats that fringe the land on both ocean and lagoon sides of islets are formed by dead corals with thin layers of mud or debris spread over them and occasional boulders scattered about as relicts of storm waves in the past. Bare at low tide and often with a somewhat unpleasant

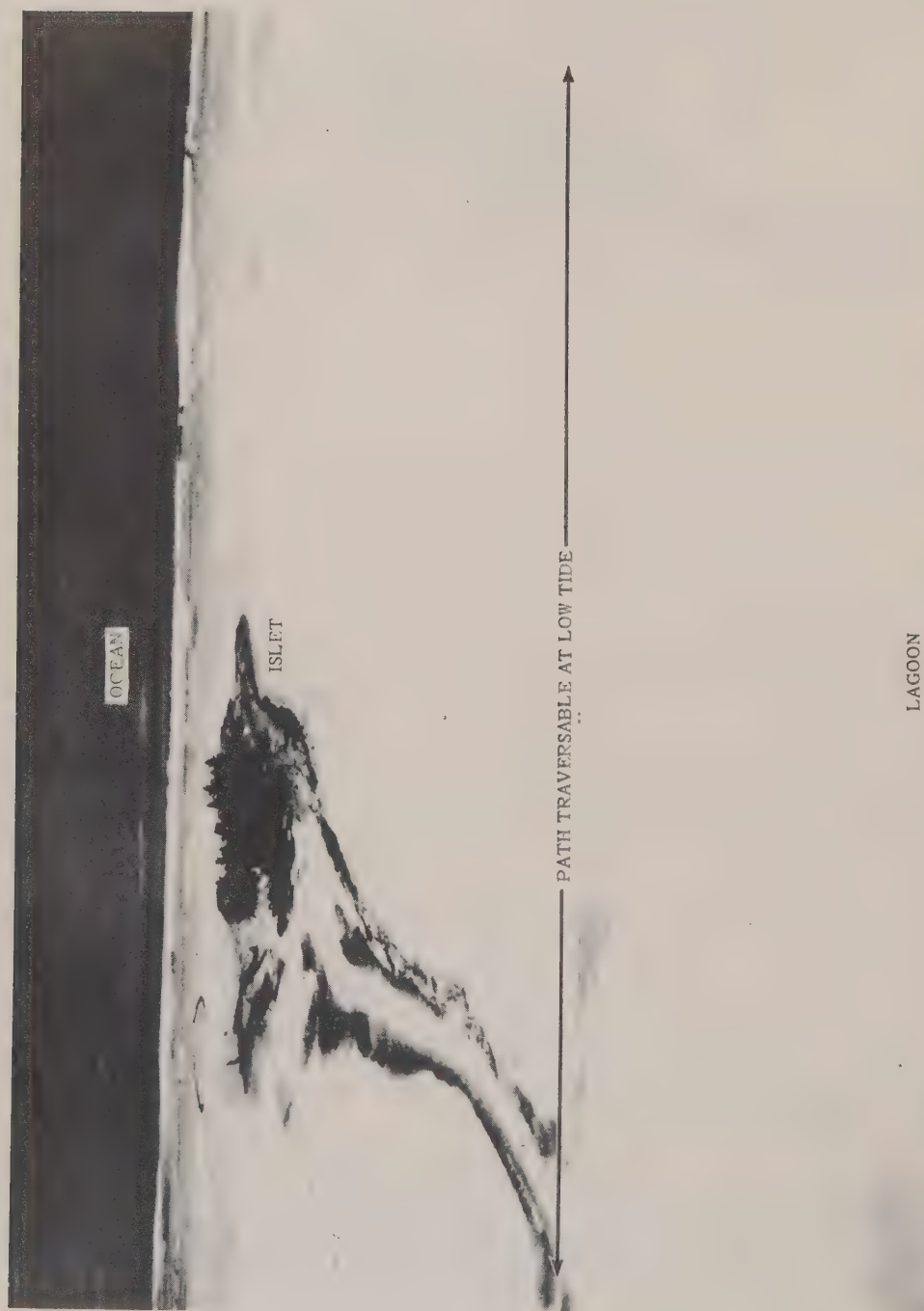


Figure 3. Aerial View of Islet Between Bairiki and Nanikai in Tarawa Atoll at Low Tide When Passage Between Islands Is Traversable by Motor Vehicles.



-- Taken from Atoll Research Bulletin No. 46.

Figure 4. Typical Conspicuous Features of an Atoll and Its Peripheral Reef.

smell from the decomposition of countless tiny organisms stranded by the low water, the reef flats are covered with several feet of water at high tide. Small wavelets ripple across them and lap up on the beaches after the main force of the waves is broken on the offshore reef slopes.

The oceanward reef margins drop off steeply into the depths, with slopes often as great as 45 degrees. Conditions for coral growth are optimal, and the offshore slope is blanketed with a profuse growth of many varieties. Elongated surge channels, oriented at right angles to the shoreline, give a striped appearance to the reef margin when viewed from the air. In the lagoon, the reefs drop off less steeply, and descend only a short distance to the bottom. The Tarawa lagoon has an average depth of only 6 to 8 fathoms.

Hydrography

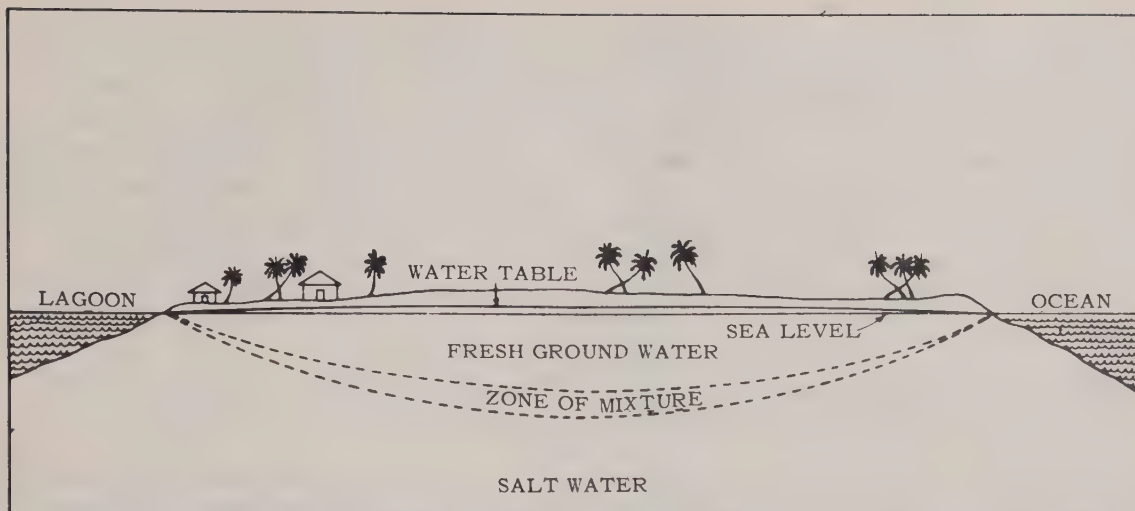
Offshore slopes, from the fringing reef down into deep water, are so steep around most of Tarawa that ships cannot possibly anchor. The exception to this statement is a small shelving area just off the lagoon entrance on the west side of the atoll in which ships can find anchorage.

The Tarawa lagoon is relatively shallow, in comparison with many atolls, and has depths ranging from a few fathoms to a maximum of about 12 fathoms in restricted areas. Many coral knolls rise near the surface, particularly in the portion of the lagoon southeast of Bikeman Island. The only part of the lagoon that is usable by ships and seaplanes lies southwest of a line drawn from Banreaba village (Eita Island) through Bikeman Island. Although in this area the most dangerous pinnacles have been marked, the HMS COOK, a Royal Navy survey vessel, is now resurveying all obstacles.

The average tidal range at Tarawa is about 4 feet, but the difference between high and low tides during spring tidal periods is 5.6 feet and during neaps is 1.8 feet (see figure 5). The datum used for the rather short periods of tidal measurement is a U. S. Coast and Geodetic Survey benchmark on Betio Island, on which the low water spring level is marked. The maximum tide measured thus far on Tarawa occurred on 11 December 1958 and reached 8.05 feet above datum; the minimum measured tide reached 1.0 feet below datum, thus indicating a maximum recorded tidal range of more than 9.0 feet. (An extremely low and irregular tide was a major contributory cause of the great number of casualties suffered by the U. S. Marines in their landing on Betio in November 1943.)

Little information is available on currents in the Tarawa area. It is known, however, that a coastwise current sets east on the south side of the lagoon, past Betio, Bairiki, and Teoraereke, a fact documented by small spits built eastward from the Betio and Bairiki moles and, on a larger scale, by the long eastward-stretching spit shape of the two islets themselves. The current in the main entrance channel into the lagoon has a strength of 1.0 to 1.5 knots, changes in direction with the ebb and flow of the tide, but is no great problem to shipping since it follows the channel axis closely.

Because of the small size of islands, low elevation, and porosity of the coral bedrock, there is no surface stream anywhere on the atoll. The lens of fresh water which accumulates and floats above the salt water, as a ground water table on each islet, must be mentioned as an important source of fresh water (figure 6). The lens tends to be much thicker and to contain fresher water in the centers of islets, whereas on the lagoon and ocean sides and at the long narrow ends of islands, the lens tends to decrease in thickness and to contain a greater amount of brackish or salt water.



- - Taken from Military Geography of Northern Marshalls.

Figure 6. Idealized Section of the Ghyben-Herzberg (Fresh Water) Lens in an Oceanic Island.

Although excessive use of the fresh water may disturb the lens, and long periods of drought will cause it to gradually disappear, it must be emphasized as a significant source of water on islands notable for their water shortage.

Climate

Tarawa lies in close proximity to the equator and has a typical oceanic equatorial climate, characterized by mildness and uniformity of temperatures but a considerable variation in rainfall. Throughout the year, afternoon mean temperatures are in the high 80's and nighttime low figures are about 76 degrees; temperatures over 95 and under 68 almost never occur, and the very consistent easterly winds moderate the heat and provide a pleasant sensible temperature. The mean annual rainfall is 64 inches, a somewhat deceptive figure since the recorded range of annual rain is from 15 inches (1950) to 115 inches (1948); droughts are a matter of periodic concern in the Central Gilbert Islands.

Wind directions are generally from east or southeast, with speeds in winter (February) averaging 17 knots, in summer about 10 knots. Although many typhoons originate close by, to the north and west of the Gilberts, none has ever been recorded at Tarawa. Both overcast and cloud-free days are rare, and the normal situation is a scattered-to-broken system of tradewind woolpack clouds, often building up as thunderheads over lagoons or during the warmer afternoon period.

Biota

The vegetation of Tarawa may be described in simplest terms as a man-made forest of coconut palms, planted wherever they will grow. Without question, the coconut palm is the dominant and most characteristic plant on the atoll. Although in the interior the coconut palms grow vertically, reaching heights of 60 to 90 feet above the ground and casting such a dense shade that other plants

often grow beneath them only with considerable effort, along the ocean and lagoon shores they lean out toward the light in long and graceful curves, in places actually extending out over the water. Other plants, of course, are present on the atoll, one of the most characteristic being the salt bush, *Scaevola*, which occurs in profusion on the ocean beach ridges and to a lesser extent on the lagoon side or sparsely scattered among the coconuts. *Pandanus*, with its curious stilt-like maze of stems, is found where light is adequate; it provides both food and excellent thatch to the natives. A few larger trees such as *Pisonia* and *Calophyllum*, with its large symmetrical glossy leaves, are scattered through the interiors of the islets. Mangroves are found near the lagoon where mud flats provide a favorable situation; their intertwined stilt roots create almost impenetrable swamps.

The diagram of figure 7 illustrates some of these relationships, and appendix A presents details of the plants found on Tarawa.

Animal life on Tarawa, if domestic cats and dogs are excluded, is restricted to small lizards and rats, but fish of a wide variety are caught in the open ocean and particularly in the lagoon. A detailed listing of species is to be found in Randall* (1955).

Bird life on Tarawa is largely restricted to sea birds. Graceful white terns, noddies, gannets, and the piratical frigate-bird, long-tailed tropic-birds, shearwaters, and petrels make up the dominant types. A few land-birds migrate through the Gilberts and are to be seen occasionally.

OWNERSHIP AND POLITICAL STABILITY

Tarawa Atoll is a part of the Gilbert and Ellice Islands Colony of the United Kingdom. The colony, which is under the jurisdiction of the High Commissioner for the Western Pacific, at Honiara, Guadalcanal, is administered by a Resident Commissioner, whose headquarters are located in the Secretariat at Bairiki, Tarawa (figure 8). For administrative purposes, the colony is subdivided into four districts (Gilbert and Ellice Islands, Ocean Island, Line Islands, and Phoenix Islands), each of which is administered by a District Commissioner. The office of the District Commissioner for the Gilbert and Ellice Islands is maintained at Betio, .3 miles west of Bairiki.

The Resident Commissioner of the Colony, Mr. M. L. Bemacchi, was on leave at the time of the author's visit in August 1959. His office was occupied by Mr. R. Davies, Acting Resident Commissioner, whose regular position is Secretary to Government. Appendix B lists key personnel of the colony and their acting and regular positions in the government.

The Gilbert and Ellice Islands Colony has as much political stability as perhaps any colony under the British flag. Although a serious strike occurred on Ocean Island in 1948, no such incident has occurred since, and it would appear that political unrest may be considered nonexistent at Tarawa.

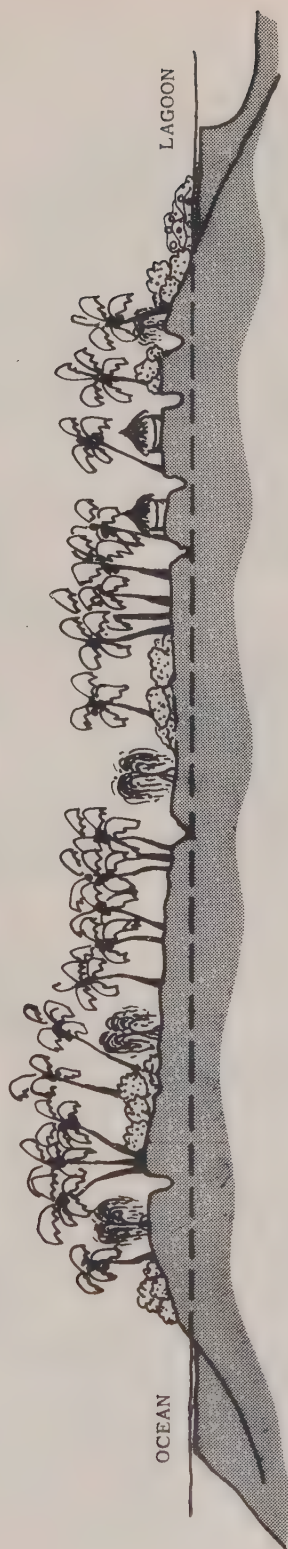
* See Selected Bibliography herein.

PHYSIOGRAPHY:

REEF	BEACH RIDGE AREA OF OCEAN SIDE	SLIGHTLY LOWER INTERIOR OF ISLAND	LOWER RIDGE OF LAGOON BEACH	REEF OR MUD FLAT
------	--------------------------------------	-----------------------------------	--------------------------------	---------------------

VEGETATION AREAS:

SCAEVOLA, PANDANUS, COCONUT	PRINCIPALLY COCONUTS, OCCASIONALLY PANDANUS, RARELY PISONIA AND CALOPHYLLUM	COCONUT, PANDANUS PEMPHIS, RHIZOPHORA
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ECONOMIC AREAS:

FISH TRAPS, COLLECTING SHELL FISH	COLLECTING COCONUTS, PANDANUS FRUIT, PALM FRONDS, COCONUT TODDY, AND THATCH	VILLAGE AREA BABAI PITS, BREADFRUIT TREES, ORNAMENTALS	COLLECT- ING SHELL FISH, WORMS, ETC.	FISHING IN LAGOON (COMMON)
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Figure 7. Physiognomic and Economic Cross-Section of a Typical Island in Tarawa Atoll.



Figure 8. Secretariat for Gilbert and Ellice Islands Colony (Headquarters of Resident Commissioner)
at Bairiki on Tarawa Atoll.

POPULATION AND CULTURAL ATTITUDES

The Gilbert and Ellice Islands Colony is unusual because the Gilbert Islands are inhabited by Micronesian people whereas the Ellice Islands have a Polynesian population. The nearly 5,000 Polynesians are a minority in the colony as compared with the nearly 37,000 Gilbertese. With 576 Caucasians and some 81 Chinese added, the population of the colony at the end of 1958 was estimated at 42,546.

As the seat of government, Tarawa has had a notable influx of population, particularly since World War II, and now has a population of 7,125 persons, of whom 141 are Caucasians. Most of the population is Gilbertese, but a considerable number of Ellice Islanders also live on the atoll. The greatest concentrations of people, including most of the Caucasians, live on the southern rim of the atoll at Betio, Bairiki, or Bikenibeu. Figures 9, 10, and 11 are maps of these areas.

Details of the colony's population, by islands, and of population trends from 1931 to 1958 will be found in appendix C.

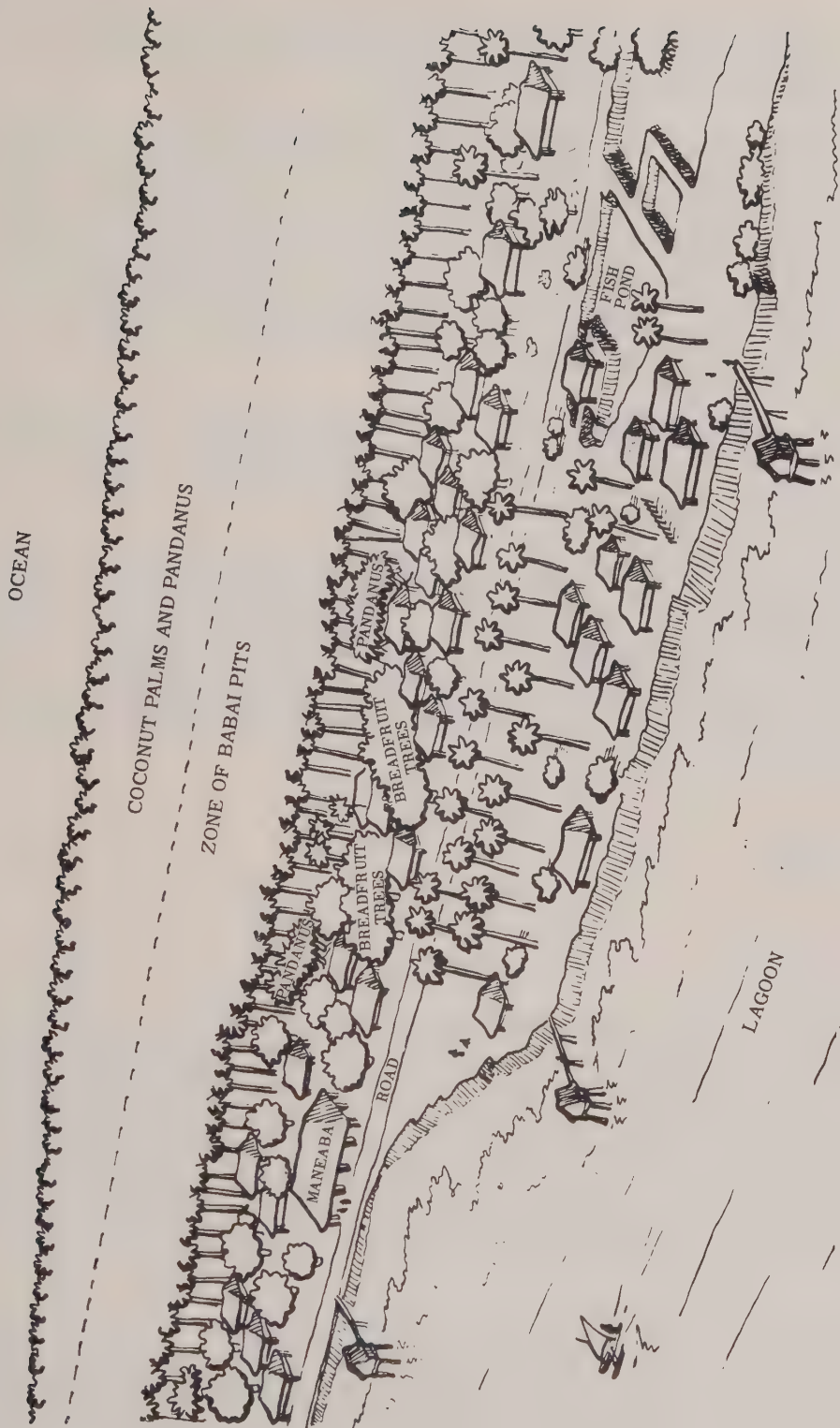
The available labor force in Tarawa and neighboring atolls is rather sizeable. Above the needs of the communities themselves, some 300 laborers are available from Tarawa alone, and with short notice it is possible to obtain 80 from Maiana, 250 from Abaiang, and 130 from Marakei, neighboring atolls. Perhaps 2 per cent of these persons are semiskilled and of use as carpenters, truck drivers, and such. Although the government itself cannot act as a recruiter of labor, a local trading firm (Schultz and Wilder) might take a contract for recruiting as it has done in the past. Unskilled labor is paid at the rate of 7 shillings per day (Australian currency, exchanged at \$2.25 per pound) or £8/5/0 (8 pounds, 5 shillings, 0 pence) per month. For long-term labor a more usual arrangement is to pay 7 pounds per month and supply food and housing. A local part-Caucasian person is usually desirable as labor boss because of his understanding of local customs and work attitudes.

Certain Gilbertese cultural attitudes must be respected if good relations are to be maintained with local people. Most of these are matters of courtesy common to most cultures; other are localized attitudes. Natives are not allowed by law (voted by themselves) to drink alcoholic beverages; hence, it is both illegal and ill-mannered to offer a native a drink. Since large physical size and manual dexterity are greatly admired, it is persons with these qualities who are able to deal most satisfactorily with the Gilbertese. A series of other local attitudes that are important for the visitor to observe is emphasized by Sir Arthur Grimble (see appendix D), who learned them during years of experience in the area.

LAND USE AND OWNERSHIP

A typical traverse of an islet on Tarawa would show coconut and pandanus occupying positions from just landward of the ocean reef flat to the edge of the lagoon (figure 7). On the lagoon half of the islet, babai pits (similar to taro pits) are commonly interspersed with the trees, which here include breadfruit and some ornamental varieties.

Villages are characteristically on the lagoon side, as are the roads or tracks connecting them, and generally contain from 15 to 50 houses constructed from palm and pandanus (figure 12). Each



-- Taken from Atoll Research Bulletin No. 59.

Figure 12. Typical Village on Island in Tarawa Atoll.

house customarily shelters one family, while the maneaba or community house, the largest structure in the village, is the meeting place of the village leaders and is used for most manifestations of native group life. Less frequently it serves as a temporary shelter for visitors.

With large populations and small land areas, the Gilbert Islands have quite high population densities. Tarawa, for example, has a density of nearly 1,000 persons per square mile, and land is at a premium. Parcels of land are subdivided often, and a person may hold several tiny bits, scattered not only on various islets of an atoll but also on several different atolls. The typical organization of people into villages, with lengthy stretches of coconut woodland lying between, only serves to disguise a situation in which land is most valuable and often very difficult to acquire. Purchase of land is possible only for natives themselves, and litigation over land is the most common type of court action in the Gilberts.

Leasing of typical coconut land or bush land for governmental purposes is not a particularly difficult problem but does require a fair amount of time (measured in months). The normal rental fee is 3 pounds Australian per acre per year and, of course, is supplemented by payment for any damage such as the cutting of trees.

A considerable area of Tarawa is currently under lease to the British government. All of Bairiki and Nanikai Islands are leased, but the former is completely utilized by the Crown and most of the latter probably will be soon. About 60 per cent of Betio Island is leased, but most of the eastern spit, on which at present only scrub and a few coconuts grow, is unleased and vacant. In the Bikenibeu area, Crown leasehold extends from the leprosarium east to the school and training college area, while at Bonriki only the airstrip itself and the adjacent causeway are under Crown lease (figure 13).

FACILITIES AVAILABLE

Transportation

Sea

Deep-draft vessels cannot enter the Tarawa lagoon but may find anchorage in 12 to 20 fathoms of water just west of the entrance; here they lie in what is normally the lee of the atoll in relatively quiet water. The entrance channel to the lagoon has a least width of 1,000 feet and is deep enough to permit vessels of 26-foot draft to enter the lagoon proper at any time; spring tides will permit vessels drawing 28 feet to enter. Pilotage is available and, although not mandatory, is usually taken by captains who do not have local knowledge. The channel itself and the anchorage area of some 4 square nautical miles west and southwest of Bikeman Island have buoys or beacons marking obstacles (chiefly coral pinnacles). No moorings exist, and vessels ride to their own anchors.

At present, all cargo from ships of any size is taken ashore in lighters. Six barges, three with flat tops and three open, are operated by the Wholesale Society and range in capacity from 20 to 40 tons. Some eight launches are in use by Government or Wholesale Society, of which three, with lengths of 22 to 35 feet and engines powered at 20 to 40 horsepower, are capable of handling the barges. With the use of the present system, it is estimated by the Marine Superintendent that the cargo-handling capacity of the port is about 500 tons per day.

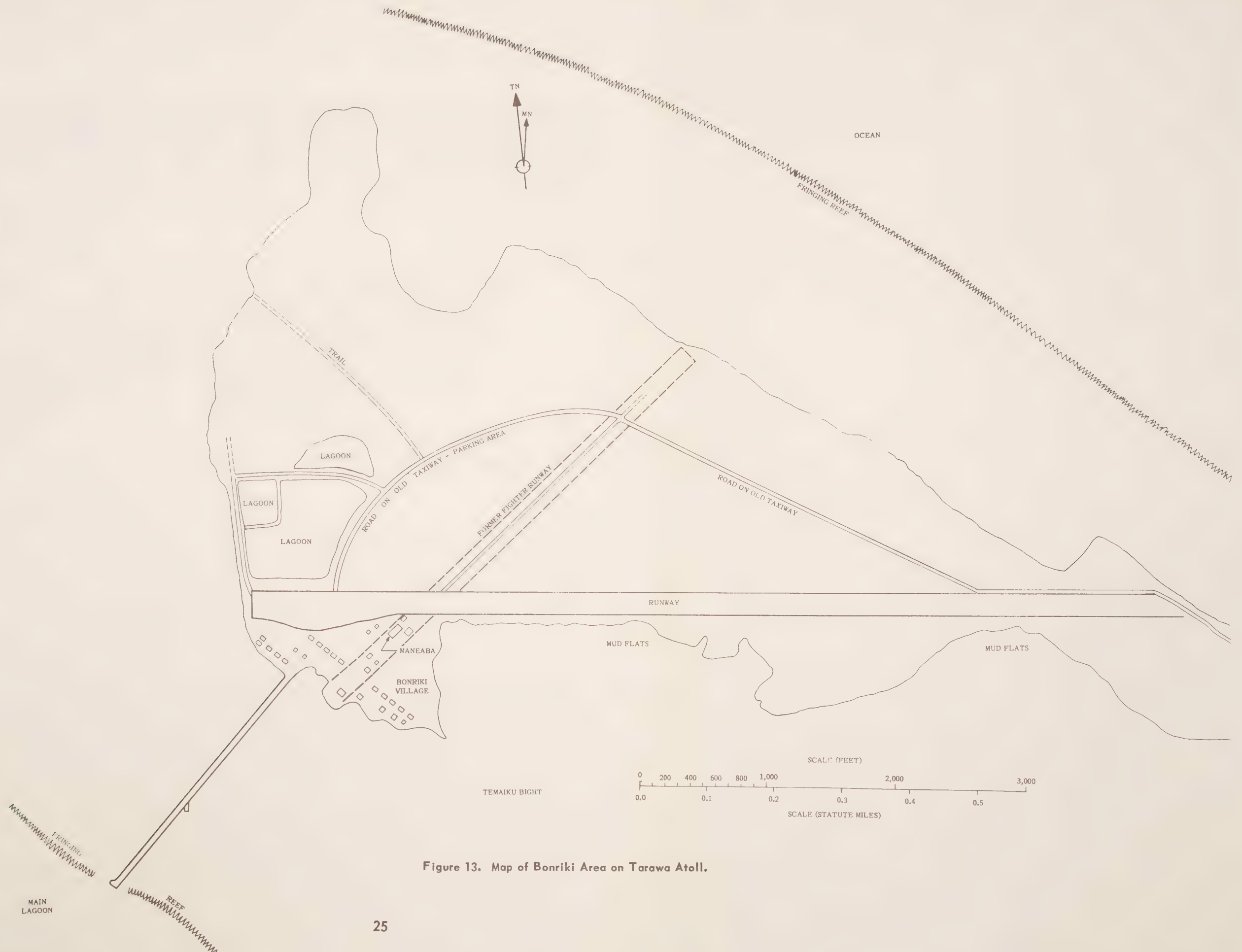


Figure 13. Map of Bonriki Area on Tarawa Atoll.

The principal harbor at Tarawa is an artificial one on the north shore of Betio Island (figure 14). A major project for harbor improvement, which is well advanced, will result in an entrance channel



Figure 14. Aerial View of Betio Harbor (Looking Southeast).

95 feet wide and 10 feet deep and an inner area 13 feet deep alongside the dock (figure 15). Some 300 feet of dock faced with sheet steel piling will have this 13-foot depth alongside, permitting any colony vessel to remain tied up at any stage of the tide. When completed, the harbor area will be well lighted, will have power lines and a transformer on the dock, and will have water lines for docked vessels to fill their tanks. (The present system requires water to be taken offshore to ships in a 15-ton capacity water barge.) Only one small 1-ton mobile crane is available at present, and future plans call for ships to handle all cargo with their own gear.

Copra is the principal outgoing bulk cargo, and sugar and flour are the principal incoming bulk cargoes; all of these are packed in sacks and handled manually. Repair facilities include the Wholesale Society boatyard, which can overhaul vessels up to 35 feet in length and can perform woodworking operations, replace planking, and the like. The Government Workshop nearby, which has metal working equipment, can repair drive shafts and can overhaul engines (figure 16).

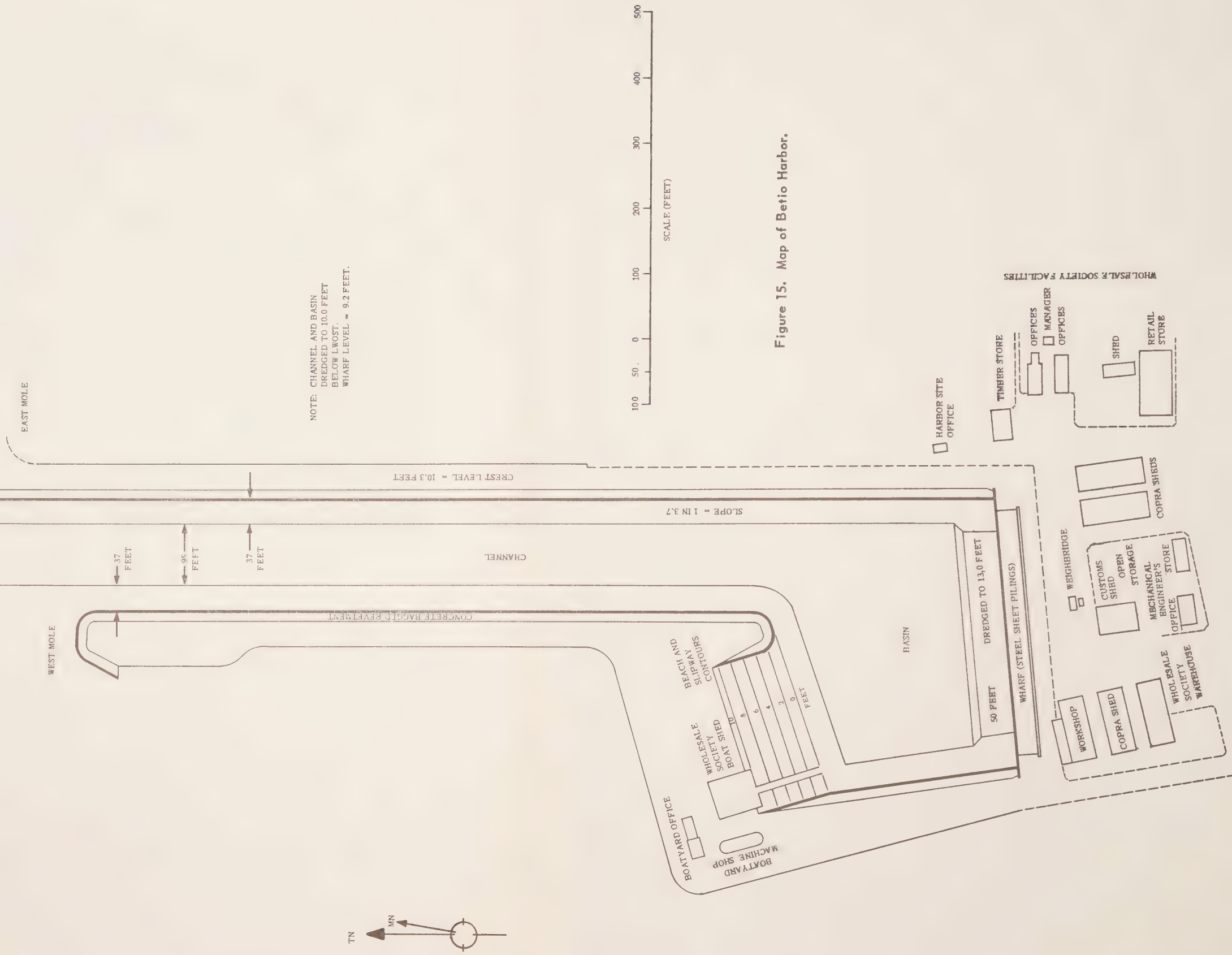


Figure 15. Map of Betio Harbor.



Figure 16. Boatyard and Ways Operated at Betio by the Wholesale Society.

Another portion of the harbor development scheme involves improvements to the boat harbor at the northwest corner of Bairiki Island (figure 17). Principal characteristics of the new harbor may be noted on figure 18. Since all connections between the colony headquarters at Bairiki and the district headquarters and the commercial activity at Betio require boat travel, a system of daily launch schedules, two boats each way, both in mornings and afternoons, has been set up to handle the traffic. A 1-shilling fee discourages joy-riders on the launches.

The mole extending into Temaiku Bight from near the west end of the Bonriki airstrip is now unused (figure 19).

Some nine ships, totalling 665 tons displacement, are in regular use in the colony for transportation among the islands (figure 20). They range in size from the 300-ton MOANA RAOI to the 10-ton FETUARO.

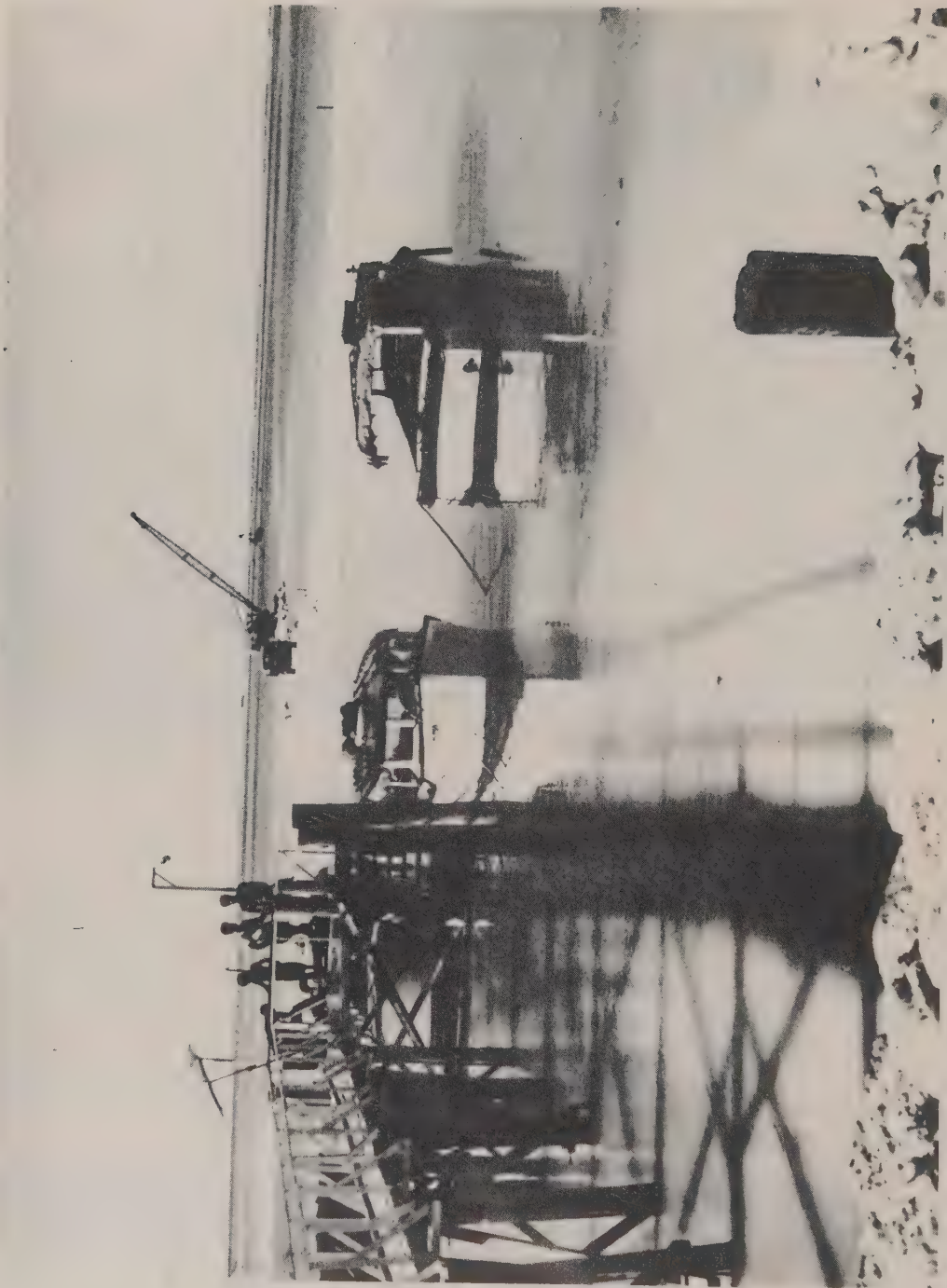


Figure 17. Boat Dock at Bairiki, With Launches Alongside and Dragline Working on Harbor Construction in Background.

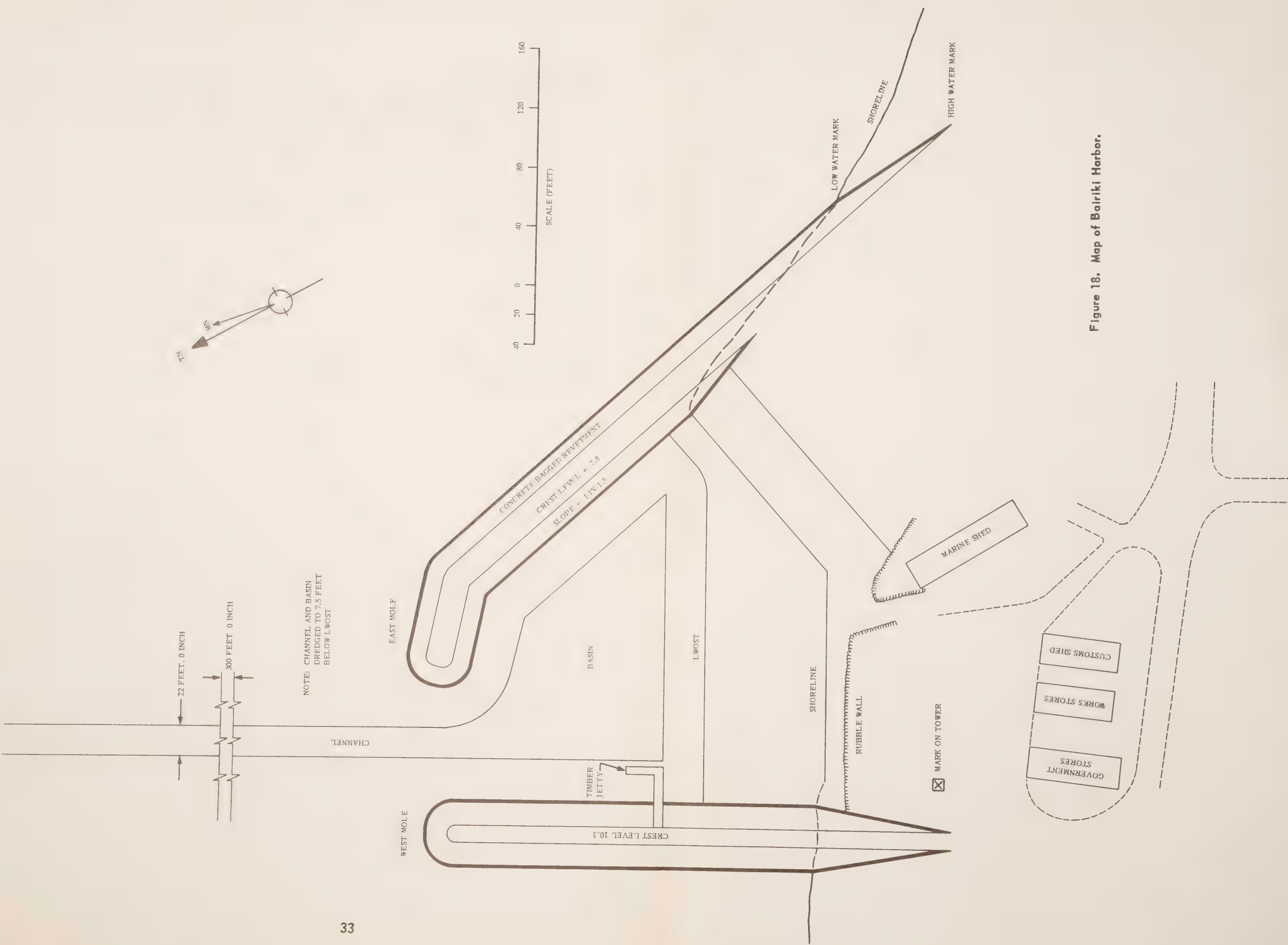


Figure 18. Map of Bairiki Harbor.



Figure 19. Unused Mole Near West End of Bonriki Airstrip (Looking Inland From Outer End of Mole in Temaiku Bight).



Figure 20. Interisland Transport Ships Operated by Gilbert and Ellice Islands Colony (From Left to Right: Nareau, Te Matopula, and Ninikoria).

Air

Of the several airfields constructed in the Gilbert Islands during World War II, only the one at Bonriki, near the southeast corner of Tarawa Atoll, remains today. All others, including the former Hawkins Field at Betio, have been replanted to coconuts and are completely unusable.

Bonriki Airfield today consists of one single runway, altitude 9 feet, oriented approximately east-west (97° - 277° true) (figure 21). The runway is 7,100 feet long, each end terminating at the water's edge without overrun. A certain amount of encroachment by coconuts and scrub has taken place along both sides of the runway, particularly about the center of the south side, but a clear width of 180 feet is still available for the entire length. The runway is made of compacted coral, which is still in good condition despite little maintenance since the war (figure 22). The bearing strength is unknown, but a 4-engine British aircraft landed on the strip in early 1959 and a Grumman UF-type amphibian aircraft landed on it three times in August 1959. American C-54's have used the field repeatedly in recent years.

The former fighter strip at Bonriki, extending northeast-southwest and intersecting the main runway, has been replanted in coconuts except for a poor road down the center. The southeast-northwest taxiway, which formerly connected the easterly portions of the two strips, and the extension of it, in a curve to west and south, which served as taxiway and parking strip, also have been replanted except for a 2-lane automobile road down the center (figure 23). Thus, except for a slightly wider area near the west end of the main airstrip, the airfield has no taxiways and no parking area (figures 24 and 25).

Except for wind socks at each end of the runway, the airfield has no other facility. Communications from aircraft to the island are with the radio station at Betio. When enough notice is given, a truck with soda-acid fire extinguishers is placed at the field to give some measure of fire protection. Again, when proper notice is given, small quantities of 100-octane aviation gasoline in drums can be made available at the field.

A seaplane landing area, used regularly by aircraft of the Royal New Zealand Air Force, is laid out in the lagoon to the north of Bairiki Island. A map of the system of buoys marking coral pinnacles and indicating the two principal directions for landing and takeoff is shown in figure 26.

Land

The road net on Tarawa consists of simple street networks at Betio and Bairiki and a road extending from Bonriki to Bairiki with interruptions at the channels between islands. For about two hours before and after each low tide, the water is low enough between islands for vehicles to cross, and it can be said that at these times a road extends for some 15 miles along the south side of the atoll (figure 27).

Most of the roads were constructed originally by the American forces during World War II. They consist of compacted coral, ranging from 16 to 24 feet in width. They have been maintained by use of a tractor-towed grader and toppings of reef mud in the chuck holes. The materials are tamped by hand because no roller is available. The slight amount of traffic gives so little wear that these rather simple maintenance methods suffice to keep the roads in good condition.



Figure 21. Aerial View of Bonriki Airfield.



Figure 22. Surface of Runway at Bonriki Airfield (Looking Eastward).



LAGOON MUDELAT

Figure 23. Central Portion of Runway at Bonriki Airfield (Looking Northward).



Figure 24. West End of Runway at Bonriki Airfield (Looking Northward).



Figure 25. Slightly Wider Area at West End of Runway at Bonriki Airfield (Looking Southeast)
(Note Truck With Fire Extinguisher at Extreme Left).

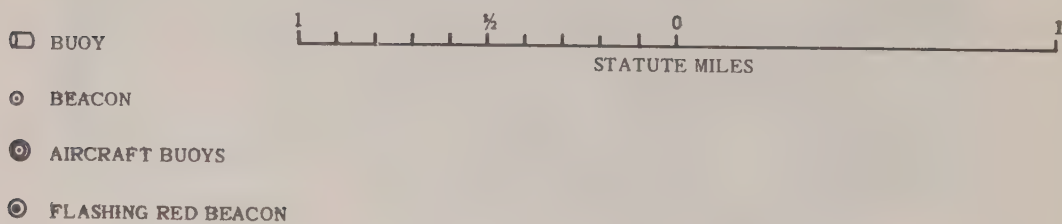
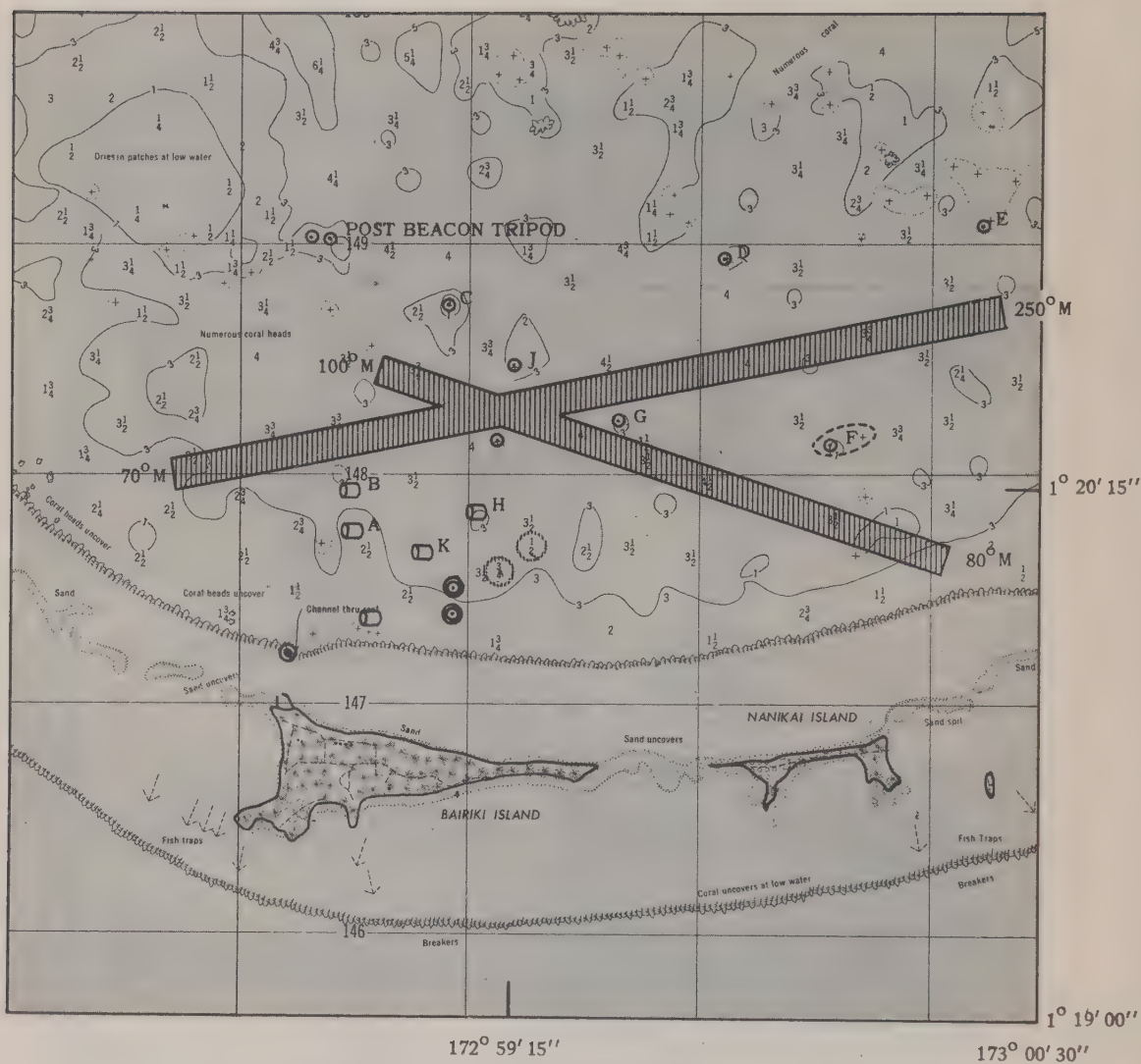


Figure 26. Map of Seaplane Landing Area North of Bairiki and Nanikai Islands Used by Royal New Zealand Air Force.



Figure 27. Land Rover in Passage Between Islands at Low Tide.

With the exception of 4 cars and 1 small truck at Betio, all vehicles on Tarawa are owned by the Government or the Wholesale Society. The vehicles are listed as follows:

	Total on Island	3-Ton Truck	Land Rover	Car	Small Truck	Ambulance
Betio	16	8	3	4	1	0
Bairiki	5	2	2	0	1	0
Bikenibeu	3	1	1	0	0	1
Total on Atoll	24	11	6	4	2	1

Maintenance of vehicles is performed at garages operated by the Wholesale Society or Government at Bairiki and Betio. The Government Machine Shop at Betio can rebuild engines and perform more complex repairs.

No true garage storage exists on the atoll, but shelters that keep off sun and rain exist for most vehicles. A gasoline pump at Betio and drums at Bairiki and Bikenibeu supply fuel.

Meteorology

All meteorological services for the colony are operated by the New Zealand Meteorological Service as part of its responsibilities with the South Pacific Air Transport Command, the over-all weather coordinating group for the South Pacific. Synoptic observations are made from 10 stations within the colony, of which Tarawa is one. Observations are made of temperature, pressure, pilot balloon flights (Tarawa and Funafuti only), rainfall, and visual observations of wind speed, direction, visibility, and cloud types. Among the instruments at Tarawa are a recording rain gage, recording barograph, and typical thermometers.

The colony staff consists of one European and 20 islanders; at Tarawa are the one European, three observers, and two trainees. The observation schedule (local times) calls for pilot flights at 0530, 1030, 1630, and 2400; for synoptic observations at 0600, 0900, 1200, 1500, and 1800; and for climatic data at 0900.

A United States meteorological station was maintained on Tarawa intermittently during 1951, 1954, 1956, and 1958 by personnel of Joint Task Force SEVEN. During these periods, rawinsonde and radiosonde observations were taken two or four times daily. When the station was abandoned in 1958, all the equipment was removed and only the buildings were left at the location. The map (figure 28) and photographs (figures 29 and 30) present data on the past and present conditions of this station.

Communications

Radio communications in the Gilbert and Ellice Islands Colony are well developed, and regular schedules are maintained between Tarawa and Honiara, British Solomon Islands Protectorate, and with Nandi and Suva in Fiji. Within the colony, some 34 stations comprise a good communications net and provide for ship-to-shore or aircraft communications. On Tarawa, because of the necessity for maintaining good communications between individual islands, with their several government offices, a VHF system is maintained which connects Betio, Bairiki, and Bikenibeu. The HF transmitting and receiving stations for Tarawa are located at Betio, toward the west end of the island (figure 31). Considerable detailed technical information on the Tarawa radio communications is given in appendix E.

Very little telephonic communication is available on the atoll. Two 6-line intercom units are utilized between various offices in the Secretariat at Bairiki, and a few field telephones connect important points such as the Secretariat, Post Office, and dock area. Betio also has a few field telephones connecting similar locations.

Storage

No open bulk storage facilities are specifically laid out on Tarawa. Although a reasonable amount of space for storage is available, this space might not be in the immediate dock areas at Betio and Bairiki, because these areas are relatively congested. In the Bonriki area, ample open storage area is available close to the causeway and airfield.

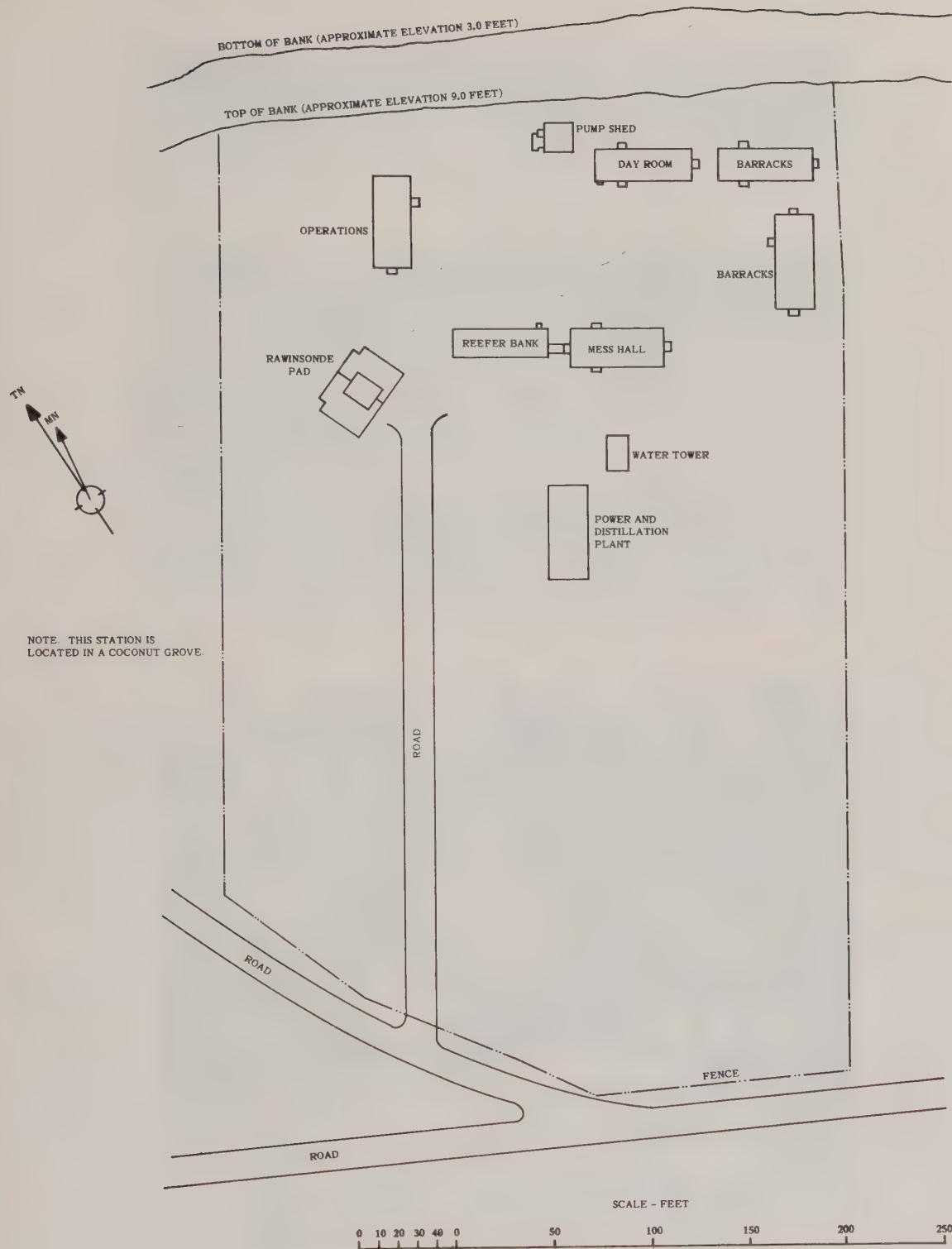


Figure 28. Map of U. S. Meteorological Station at Betio.



Figure 29. Aerial View of Meteorological Station at Betio.



Figure 30. Buildings in Meteorological Station at Betio.



Figure 31. Transmitter Building at Betio.

Most covered storage or warehouse capacity on Tarawa is in the form of Nissen (Quonset-type) buildings (figure 32). At Bairiki, five large Nissen warehouses (24 by 60 feet) are used for governmental purposes, one covered shed (40 by 75 feet) is used for lumber storage, and a large Wholesale Society store and storehouse are combined. Storage facilities at Betio comprise eight large Nissen copra sheds or warehouses (40 by 100 feet), a customs shed (40 by 60 feet), about 10 smaller Nissen warehouses (20 by 100 feet), and a thatched timber storage area (about 30 by 50 feet). Most of this storage area is filled to capacity. Half or perhaps an entire copra shed (Nissen hut, 40 by 100 feet) might be made available temporarily in case of emergency.

Refrigerated storage on Tarawa is limited to two 150-cubic-foot reefers at Betio, housed in a 24-by-30-foot building. Another 300 cubic feet of storage is expected to be available by October 1959.

All petroleum products are now stored in drums at an open-storage area of 150 by 240 feet (figure 33). However, plans are being considered for bulk storage of POL near the harbor, including a 120,000-gallon tank for ship diesel fuel. Normal stocks of POL products in 55-gallon (U. S.) drums, are maintained as follows:

	55-Gallon Drums	5-Gallon Tins
100-octane aviation gasoline	200	
Aviation lubrication oil	6	
Automobile gasoline	300	
Kerosene	400	60



Figure 32. Nissen Building Used as Warehouse Near Dock at Bairiki.



Figure 33. Open Storage Area for Petroleum Products at Betio.

	55-Gallon Drums	5-Gallon Tins
Ship diesel oil	2,000	
Ship lubrication oil	40	
Denatured alcohol	80	
Sundry specialized greases and oils		

Utilities

Water Supply

Water supply on Tarawa is a problem because of low and irregular rainfall, small land area, and lack of surface streams or lakes. The basic source of water is the freshwater lens which overlies the salt water in the substrata of each island. Wells are dug down to this water table. Some 300 wells in all serve the general population for all purposes in the three areas of Betio, Bairiki, and Bikenibeu. Well water is hard and tends to get progressively more brackish as a drought period persists. Water trucks, filled from the larger wells, distribute water to the individual government house tanks several times a week.

All drinking water for the Caucasian population is rainwater obtained from catchments on the individual houses. It is stored in an 800-gallon tank near each kitchen. Even this water is filtered and boiled before it is used by most Caucasians. Three large cisterns at Bairiki and Betio, which have a capacity in all of about 150,000 gallons, are used to store water obtained from the government catchment areas.

During the periods in which the U. S. Meteorological Station on Betio was occupied, all of the water used by the unit was distilled from sea water.

Electric Power Supply

The electrical systems installed on Tarawa have the following characteristics: 415 volts, 3 phases (or 240 volts, 1 phase), 50 cycles per second, with distribution on a 4-wire (3 phases plus neutral) main line. Transformers are available which can provide 110 volts for small loads.

Betio is provided with two 82-kilowatt Ruston generators. The peak load is estimated at a little more than 60 kilowatts, leaving one generator as standby. In addition, two 19-kilowatt Southern Cross generators are used as emergency standby equipment for the radio communications facility.

Bairiki has an 82-kilowatt main generator and a 69-kilowatt standby generator. Bikenibeu has an 82-kilowatt main generator, a 10-kilowatt standby generator for emergencies in the operating room at the hospital, and a 75-kilowatt generator on order which will be used as a standby.

In addition to the government offices, shops, docks, radio station, and other users, power is distributed to government housing at the three main government centers. Both Betio and Bairiki have service for about 18 hours per day; Bikenibeu has service for about 12 hours per day.

Sewage and Waste Disposal

Sewage from all Government Grade B (Caucasian) and Grade C (top native employees) housing is disposed of in individual septic tank systems, one for each house. All other persons on the atoll use latrines built out over the lagoon reef and connected by walkways to the shore. A septic tank system is installed at the site of the U. S. Meteorological Station.

Garbage is collected by truck twice a week and is burned on the reef. The unconsumed remains are carried off by the sea.

Maintenance Facilities

The principal maintenance facility is the Government Workshop located in the Betio dock area. Available equipment includes two metal lathes, a shaping machine, a vertical drilling machine, two grindstones, a valve grinder, an electric welding plant, and an oxyacetylene plant. The type of work accomplished here ranges from complete overhaul of diesel engines (up to 100 horsepower) to repair of vehicles and maintenance and repair of generators. Replacing parts is a problem because a relatively small stock is kept on hand.

The Wholesale Society (Betio) and the Government (Bairiki) have vehicle maintenance shops with compressors, grinders, battery-charging equipment, and grease racks or pits. The Wholesale Society boatyard at Betio and the Government carpenter shop at Bairiki have woodworking machines such as routers and planers.

Fire Protection

There is no formal group of personnel continuously on duty for fire protection. When an alarm is given, a group of laborers on each island assembles for fire-fighting under the supervision of a Caucasian. The two trucks (at Betio and Bairiki) which are used during the day for distribution of water to houses are left filled each night for use in an emergency. In addition, there are four 35-gallon extinguishers on wheels (2 at Bairiki, 1 each at Betio and Bikenibeu). As further protection, each Grade B house has two hand extinguishers (carbon tetrachloride and soda acid), and each Grade C house has a soda acid extinguisher. Among the smaller houses, a soda acid extinguisher is maintained for every 10 structures. Buckets are kept at hand in all main buildings. An alarm system is maintained. With the equipment outlined above, there have been few serious fires despite the apparent hazard of thatched roofs on most buildings.

Police Protection

Although the Superintendent of Police for the Colony is located on Ocean Island, the principal police officer for the Gilbert and Ellice Islands District, entitled Inspector of Police, has his headquarters on Tarawa. The forces for each of the main areas consist of: a Station Sergeant and 9 police at Betio; the Inspector, a Sergeant, and 15 police at Bairiki; and 1 policeman at Bikenibeu. A part-time local village policeman is stationed in each of the other villages on the atoll.

The principal jail for Tarawa, located at Bairiki, has a capacity of 21 male and 7 female prisoners at any one time.

Housekeeping Facilities and Personal Services

Quarters and Food Supply

Although the British have completed an appreciable program of construction of permanent housing on Tarawa, all housing is occupied and no facility is immediately available for even a small visiting party (figure 34). Some hundreds of houses have been built, but only 34 meet standards for occupancy by Caucasians. There is no hotel nor guest house of any description. Billeting of a visiting group would be difficult. Two qualifications to the above statements may be pointed out:

1. The buildings at Betio formerly occupied by the U. S. Meteorological Station are vacant at present and could provide shelter for an official party (figure 30). However, all equipment, bedding, messing, food, and the like would have to be brought in by the visiting group.
2. An official visiting party might be provided quarters, if plans were properly coordinated, at the Royal New Zealand Air Force facility at Bairiki (figure 35). These quarters were established for use by the crews of RNZAF aircraft which visit Tarawa approximately every two months on training flights. The facility, which has room for 6 officers and 15 enlisted men in two buildings, includes a separate cook and wash house (figure 36). Bedding and utensils are left in the buildings. All that is required of a visiting party is to supply its own food and to hire local labor as cooks and orderlies. If formal arrangements were made with the RNZAF at Lauthala Bay (near Suva), Fiji, it might be possible for a group to occupy these quarters between the periodic visits by the RNZAF.

Any visiting party of more than two persons would, at the least, have to supply its own food, and very probably would have to supply its entire bedding and messing needs.

Medical and Dental Care

The principal hospital for the Gilbert and Ellice Islands Colony is located at Bikenibeu, near the southeast corner of Tarawa Atoll. The staff is comprised of 5 Caucasians (2 doctors, 2 nurses, 1 pharmacist), 3 assistant medical officers (natives trained at the medical school at Suva, Fiji), 15 native nurses, 15 dressers (about the same as first aid men), and about 20 cooks, janitors, and other workers.

The hospital has beds for 6 Caucasian patients, 83 native patients, 15 mental patients, and, in an adjoining area, facilities for handling 70 leprosy cases. A fully equipped operating theater, X-ray machine, and facilities for simple laboratory tests comprise the major equipment at the hospital.

Operations such as appendectomies and hernias and maternity cases are routine for both Caucasians and natives, but more involved medical problems, so far as Caucasians are concerned, are handled by specialists in Australia or Fiji. An assistant medical officer, specialized in dentistry, does oral surgery and makes dental plates.

Laundry and Cleaning Services

No commercial drycleaning or laundry facilities exist on Tarawa. Local laundresses do all washing, houseboys do minor cleaning, and fancy cleaning is mailed to Australia or Suva for processing.



Figure 34. Grade D Government Housing Occupied by Gilbertese Couple in Foreground.



Figure 35. Royal New Zealand Air Force Quarters at Bairiki (Quarters for Enlisted Men in Center, With Officers' Quarters at Extreme Right and Cook House at Extreme Left).

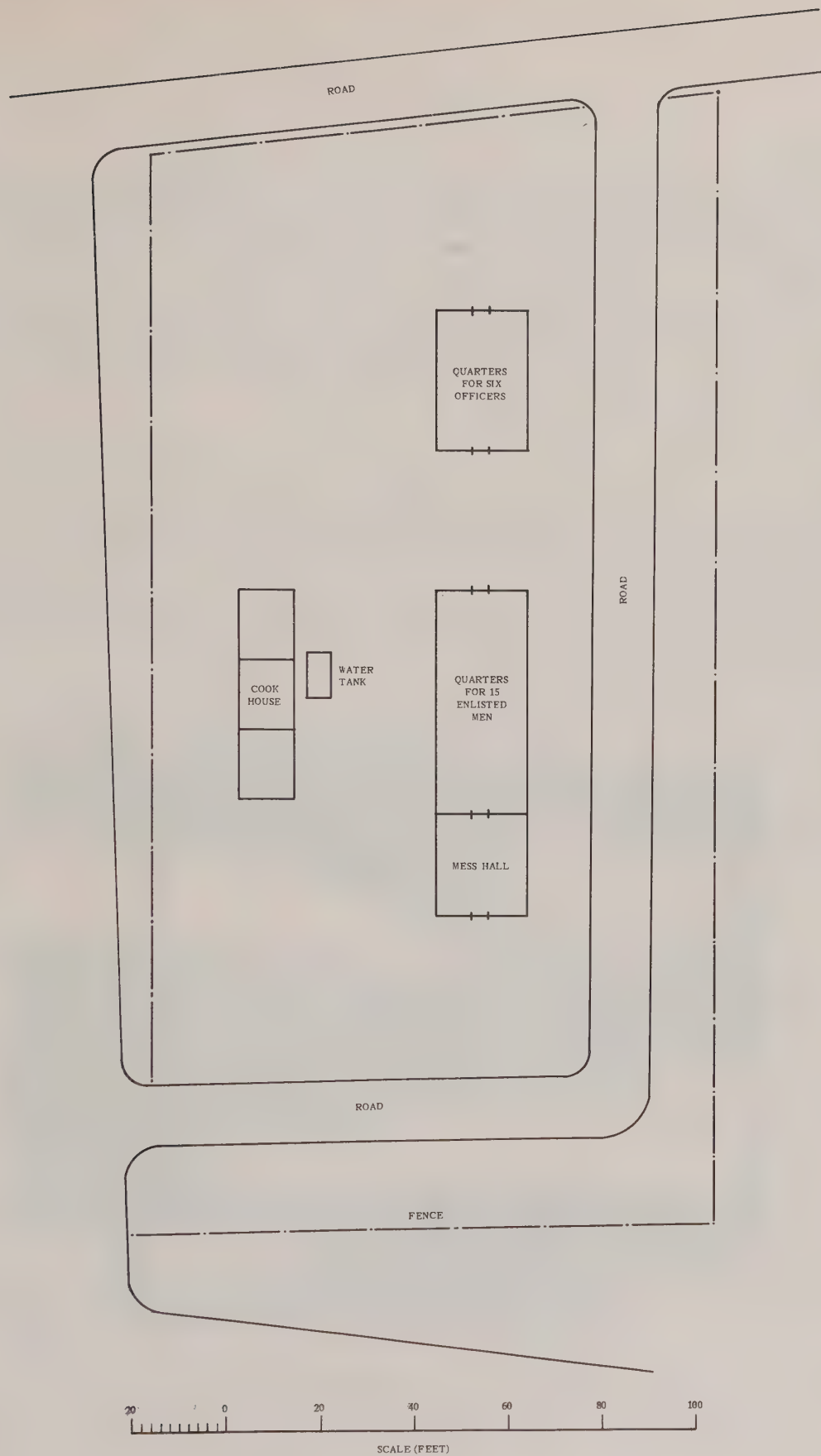


Figure 36. Map of Royal New Zealand Air Force Facility at Bairiki.

Religion

Although there are small congregations of people who profess the Bahai, Church of God, and Seventh Day Adventist faiths, most of the population of Tarawa is divided approximately half and half between Roman Catholics and members of the London Missionary Society (closely related to Methodism).

A Catholic church is located in every village, and a small LMS church is located on every islet of the atoll. On Tarawa are a Catholic bishop, two priests, and about four nuns who are expatriates, and also Caucasian pastors of the Bahai and Church of God faiths. Native pastors represent the other religions.

Education

In Tarawa, no school is available which maintains European standards of education. Caucasian children, at about age 9, are sent off to boarding schools in Australia, New Zealand, or England.

The King George V School (figure 37) at Bikenibeu is the principal school for the colony. It provides secondary education to native boys from all over the colony. The Education Officer and Headmaster of the school are expatriates.



Figure 37. King George V School at Bikenibeu (Assembly Hall at Right and Administration Building at Left).

Recreation

Commercial recreation facilities are absent from Tarawa, with the exception of two open-air movie theaters at Betio and one at Bairiki. These theaters charge 12 cents admission and present programs dominated by old cowboy movies and adventure films. Caucasians have organized clubs at Betio and Bairiki which serve as focal points for social activities; each has a bar, billiards, darts, and other typical club facilities. Tennis courts are available at Betio and Bairiki, and sports grounds for cricket and rugby are located at these villages and at Bikenibeu. Fishing, sailing, and skin diving provide other recreational outlets.

Construction

Except for reef detritus used as aggregate for concrete, no construction material whatsoever is available at Tarawa. All cement, steel, and lumber are imported for specific jobs, and there is never any excess for casual purchase or use. Coral debris from the reefs is used to good advantage in concrete after it is washed and screened. Small (3/16-to-3/4-inch) and large (3/4-to-2-inch) sizes are used; fine particles and the few particles over 2 inches are discarded. Well water, fresh to brackish, is used in making concrete, but seawater can be used if necessary; in the latter case, the curing period is longer and the early strength of the concrete is lower.

All construction equipment has been imported for special purposes, principally for the harbor construction project. The equipment list comprises a 5/8-yard dragline, a 50-horsepower bulldozer with winch, 2 Morris 3-ton tippers, 4 concrete mixers (10-cubic-foot), a trailer-mounted compressor, and a diesel piling hammer. The piling hammer, a Delmay model D5, is used for driving the steel sheet piling for the Betio wharf.

Local construction costs can be roughly approximated from the cost of the Bairiki Secretariat (figure 8) which amounted to \$37,000. The cost factor probably is 2.5 to 3.0 times that of Washington, D. C.

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APPENDIX A
VEGETATION OF GILBERT ISLANDS
(Source: Atoll Research Bulletin No. 59, pages 79, 80.)

With the exception of *Pemphis* stands and, of course, of the mangrove proper, no primitive vegetation types can be recognized today. The original formations have been so thoroughly modified by man that there is no trace left of them, especially as all these islands are rather densely populated.

Besides the coconut palm, which covers the largest area, some species may still have a certain density and show marked preferences for some habitats, but they form a secondary vegetation rather than ruins of former original types.

In many cases the primary components are now represented only by isolated specimens, which tend to disappear not only because of the growing prevalence of the coconut palm but also because the natives do not care to preserve or propagate them. This is the case for trees such as *Pisonia*, *Cordia*, etc. In some islands even valuable trees such as pandanus may be disappearing, as they are considered of minor importance in comparison with the commercial value of copra.

The Gilbert Islands offer today the following vegetation types:

I. Vegetation of the seaward side

Scaevola, more or less dense, forms an almost unbroken belt. Their density is always greater than that of other neighbouring plants. This species grows nearest to the shore. *Messerschmidia* in isolated specimens or small groups are found, most of them with twisted trunks. Their height does not exceed 3 m. *Pandanus*, are more or less numerous, but always as isolated individuals. The prevailing low plants are: *Lepturus*, which is very seldom found in the shaded central zone, and *Fimbristylis*. A few *Triumfetta* and *Cyperus* sometimes grow among them. The coconut palm begins in this zone, the first rows growing a little above high-water mark.

II. Vegetation of the interior

The area occupied by other species is usually conditioned by the density of the coconut palms. If these are very close together, we find only the following low plants: *Thuarea*, *Fimbristylis*, *Euphorbia* and gramineae of the genera *Stenotaphrum* and *Cenchrus*, with a few small *Scaevola* here and there. If the coconuts are less dense, there will be some tree species such as: *Pandanus*, *Guettarda* and *Morinda*; and in addition to the low plants already mentioned, *Boerhavia*, *Triumfetta*, *Fleurya*, *Sida*, *Dodonaea* and *Cassytha*. The grasses are almost all present and *Psilotum* and *Polypodium* occur here and there at the foot of the coconut trees. Of course the number of these plants and the area they cover vary with the degree to which the ground is tended. If the coconut palms are very sparsely planted, some trees such as *Cordia* and *Pisonia* may occur, though rarely nowadays.

Many low plants survive with difficulty in open areas while species such as *Sida fallax*, which seem to prefer strong sunlight, can achieve great extension there.

III. Vegetation of the lagoon side (area of roads and villages)

The roadsides being generally cleared to a certain width, few plants are to be found there except common grasses. On the other hand, the shrubs and trees of the interior may be found again between the cleared road zone and the edge of the lagoon, with the addition of small groups of *Messerschmidia* forming a narrow strip slightly in front of the coconut palms.

One plant will be found growing densely on sandy areas that are always damp below the surface through tidal seepage; this is *Fimbristylis*, which tolerates high salinity. On the contrary, *Scaevola*, *Guettarda* and *Lepturus* always grow above the level of the highest tides.

Village areas offer a very different aspect, due to the number of plants cultivated in their immediate vicinity and around the houses. Among food trees, in addition to coconut palms which are widely spaced, breadfruit trees predominate, and sometimes reach a large size. Pandanus trees are found in varying numbers, mostly around the village periphery, except in the southern islands where they are given the same choice locations as *Artocarpus*. Papaya trees are found in every village and are often very tall. Banana plants are sometimes a component of this vegetation, but are grown only in pits. Small pumpkin patches are seen around the houses in southern islands, generally side by side with numerous tobacco plants, while *Ficus tinctoria* is usually found a little behind the last houses. Tomatoes and sweet potatoes are very scarce and we saw them only on a few islands in the centre and north of the Gilbert Group.

One of the characteristics of the Gilbertese village is the great variety of ornamental plants. The most commonly found are *Crinum*, *Russelia*, *Mirabilis*, *Catharanthus* and *Pseuderanthemum*. The low plants considered as weeds vary in abundance, of course, according to the cleanliness of the village and are, in fact, rather scarce. *Euphorbia prostrata*, *Fimbristylis*, *Phyllanthus*, *Eragrostis* and *Digitaria* are most often seen.

In addition to village and roadside vegetation, the *Pemphis* type should be given special mention. This shrubby plant (*Pemphis acidula* Forst) forms thick stands, often spreading over large areas, just at the limit of the highest tides of the lagoon, and above the first depressions filled by high tides and occupied by *Rhizophora*. The latter may often cover large areas which are submerged at high tide.

APPENDIX B

KEY PERSONNEL OF GILBERT AND ELLICE ISLANDS GOVERNMENT

Name	Position in August 1959	Temporary Rank	Permanent Position	Permanent Rank	Location
Bernacchi, M. L.	On leave	-	Resident Commissioner	1	Bairiki
Davies, R.	Acting Resident Commissioner	1	Secretary to Government	2	Bairiki
Turpin, R.	Acting Secretary to Government	2	Administrative Officer, Class B	-	Bairiki
Roberts, R. G.	District Commissioner, Gilbert and Ellice Islands	3	District Commissioner, Gilbert and Ellice Islands	3	Betio
Rees, W. H.	Acting Chief Medical Officer	4	Medical Officer	-	Bikenibeu
Shaw, J. A.	Acting Accountant General	5	Accountant	-	Bairiki

APPENDIX C
POPULATION OF GILBERT AND ELLICE ISLANDS COLONY

Table C-1. Breakdown of Population in Gilbert and Ellice Islands Colony.
Table C-2. Population Trends in Gilbert and Ellice Islands Colony.

Table C-1. Breakdown of Population in Gilbert and Ellice Islands Colony.
(Estimates as of 31 December 1958)

Location	Total	Native	Caucasian	Mongolian
GILBERT AND ELLICE ISLANDS DISTRICT:				
Makin	1,130	1,129	-	1
Butaritari	2,118	2,116	2	-
Marakei	1,790	1,787	3	-
Abaiang	3,234	3,226	8	-
Ta-awa	7,125	6,982	141	2
Maiana	1,359	1,358	1	-
Abemama	1,341	1,334	7	-
Kuria	541	540	-	1
Aranuka	571	571	-	-
Nonouti	2,143	2,140	3	-
Tabiteuea	3,266	3,261	5	-
Beru	1,968	1,965	3	-
Onotoa	1,542	1,542	-	-
Nikunau	2,011	2,008	3	-
Tamana	1,142	1,142	-	-
Arorae	1,551	1,551	-	-
<i>Subtotal for Gilbert Islands</i>	32,832	32,652	176	4
Nanumea	928	928	-	-
Nanumanga	513	513	-	-
Niutao	731	731	-	-
Nui	485	485	-	-
Vaitupu	822	822	-	-
Nukufetau	579	579	-	-
Funafuti	567	562	5	-
Nukulaelae	270	270	-	-
Niulakita	43	43	-	-
<i>Subtotal for Ellice Islands</i>	4,938	4,933	5	0
<i>Total for district</i>	37,770	37,585	181	4
OCEAN ISLAND DISTRICT:				
<i>Total for district</i>	2,381	2,135	170	76
PHOENIX ISLANDS DISTRICT:				
Canton ^a	368	179	189 ^b	-
Hull	729	729	-	-
Gardner	183	183	-	-
<i>Total for district</i>	1,280	1,091	189 ^b	0
LINE ISLANDS DISTRICT:				
Washington	305	304 ^c	1	-
Fanning	436	401 ^c	34	1
Christmas ^d	374	373	1 ^d	-
<i>Total for district</i>	1,115	1,078	36	1
GRAND TOTAL FOR COLONY	42,546	41,889	576	81

a - Condominium of United States and United Kingdom.

b - Caucasian population in June 1956.

c - Including a few "mixed race".

d - Excluding military forces.

Table C-2. Population Trends in Gilbert and Ellice Islands Colony.

Racial Segment	1931		1947		1958 ^a	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Micronesians	28,946	85	29,923	83	36,956	87
Polynesians	3,668	11	5,006	14	4,933 ^b	12
Mongolians	728	2	142	-	81	-
Caucasians	249	1	304	1	576	1
Mixed	231	1	565	2	?	
Total	33,822	100	35,940	100	42,546	100

a - Estimated by Government officials.

b - Total of Ellice Islands population, excluding 5 Caucasians.

APPENDIX D

SOME AVOIDANCES TO BE OBSERVED IN RELATIONS WITH NATIVES

(Source: Grimble, A. R. Instructions and Hints to District Officers. Suva: J. J. McHugh 1929.)

1. *Don't* expect to know the native until you have learned his home life. *Don't* expect to learn his home life except by constant hut-to-hut visitation. *Don't* expect to have any influence with the native until he knows that you know him.
2. *Don't* attempt to drive a native; lead him. *Don't* attempt to frighten him; he cannot be frightened physically.
3. *Don't* say anything that sounds like boasting or self-aggrandisement. There is a native proverb: "He owns no land, so his words are big."
4. *Don't* speak loud. There is another Gilbertese proverb: "A chief whispered: I swooned. A slave shouted: I awoke to laugh."
5. *Don't* reproach a native for bad manners until you are sure that you yourself are good-mannered according to his code.
6. *Don't* threaten or even speak of a native's head; it is sacred.
7. *Don't* point with extended finger; bend the finger and point with the knuckle.
8. *Don't* walk upright between two natives engaged in conversation. Bow the head, so as to clear their line of vision.
9. *Don't* forget to answer: "Te raoi" (peace!) if a native says "Ko raba" (thank you!).
10. *Don't* walk through a seated crowd without the preliminary courtesy: "E matauninga te aba?" (Are the people offended?). Say this and await the answer: "E aki matauninga, na rikai" (They are not offended, pass this way). Then proceed.

APPENDIX E

COMMUNICATIONS IN GILBERT AND ELLICE ISLANDS COLONY

The communications network in the Gilbert and Ellice Islands Colony consists of 34 stations, listed in table E-1. Regular contacts also are maintained with several other communications points outside the colony.

Communications equipment at Tarawa, which is the Government center of the colony, includes the transmitters detailed in table E-2, the receivers detailed in table E-3, and the VHF transmitter-receiver system described in table E-4. The test equipment at Tarawa, used to keep the communications equipment in good operating condition, is listed in table E-5.

The communications operations at Tarawa can be classified as point-to-point communications, shore/ship communications, ground/air communications, aircraft navigational aid, and local broadcasting service. The usage of equipment at Tarawa in these operations is described in tables E-6, E-7, and E-8.

The layout of receiving/operating positions, the staffing of receiving and transmitting stations, the stocking of spare units, and the maintenance of equipment at Tarawa are all simplified by an arrangement in which certain individual equipments are used at different times for different circuits, usually but not necessarily on the same frequencies. This arrangement is shown by the Tarawa radio schedules for 1 September 1959 detailed in table E-9. Although some circuits appear to be inadequately provided with night or secondary frequencies, local officials say that doubtless allocations would be available if the necessity arose or if the period of service were extended from the present 18 hours per day to 24 hours per day.

The normal working frequency for shore/ship communications is 4108.4 kilocycles, and the alternate frequency is 6282 kilocycles (which is limited to CW). The Pacific area small ships distress frequency is 2182 kilocycles. It should be noted that the Colony ships are not equipped to use the international distress frequency of 500 kilocycles.

Broadcasting in vernacular is limited at present to 1 hour per week on the frequency of 6050 kilocycles. One of the communications transmitters (radiating 200 watts) is borrowed for these broadcasts. The programs are tape recorded by the Information Office personnel at Bairiki, who have audio facilities and a Ferrograph (English) tape recorder. The taped programs are fed into the transmitter on Sundays from 1640M to 1715M (local time). The programs, which are half Gilbertese and half Ellice, include reports of colony news and local music. Although the reception is limited to the Gilbert and Ellice groups, reports are usually favorable. There are not very many private radio receivers outside Tarawa, but community listening is popular.

Broadcasting in English is scheduled for 2 hours per week on the frequency of 844 kilocycles. The program is broadcast by use of locally constructed studio equipment and a locally constructed low-power transmitter. The programs, which consist of local news reports, music, and British Broadcasting Corporation feature transcriptions, are presented on Fridays from 1930M to 2130M (local time). This low-power broadcasting station is located near the transmitting station for colony communications.

At the end of 1959, a new 2.5-kilowatt transmitter is being installed in the transmitting station, a remote studio is being installed on Betio, and another studio is being installed in the Information Office at Bairiki. This transmitter equipment, which is manufactured by Standard Telephones and Cables, Ltd. (Australian), will require a 3-phase AC power input. The associated audio equipment to be used in the remote studios is mostly manufactured by Amalgamated Wireless Austrasia, Ltd. (Australian) and PYE (English). A special high-angle radiation antenna, termed a vertical incidence array, will be used with this new transmitter. The radiation will be limited to the Gilbert and Ellice Islands, but a reliable service area is anticipated.

When this new broadcasting equipment is put into operation, the vernacular programs probably will continue to be recorded in most instances, but under better conditions. However, live programs from the new remote studio on Betio will be possible.

Although the studio equipment probably will be used to produce live programs for the English broadcasts, it is not proposed at present to use the new transmitter for the English service. Probably, the low-power transmitter will be moved to the transmitting station and the small building which now houses the low-power transmitter will be demolished.

**Table E-1. Wireless Stations in
Gilbert and Ellice Islands Colony.
(Total of 34 Stations in Colony)**

Station	Call Sign
Gilbert Islands (19 Stations):	
Headquarters, Tarawa	VSZ
Bairiki, Tarawa	VSZ 39
Bikenibeu, Tarawa	VSZ 40
Abaokoro, Tarawa	VSZ 38
Makin	VSZ 35
Butaritari	VSZ 32
Marakei	VSZ 34
Abaiang	VSZ 33
Maiana	VSZ 37
Abemama	VSZ 36
Kuria	VSZ 25
Aranuka	VSZ 26
Nonouti	VSZ 24
Tabiteuea	VSZ 23
Beru	VSZ 27
Onotoa	VSZ 29
Tamana	VSZ 30
Arorae	VSZ 31
Nikunau	VSZ 28
Ellice Islands (9 Stations):	
Nanumea	ZJU 22
Nanumanga	ZJU 27
Niutao	ZJU 24
Nui	ZJU 23
Funafuti	ZJU
Vaitupu	ZJU 25
Nukufetau	ZJU 28
Nukulaelae	ZJU 29
Niulakita	ZJU 26
Ocean Island (1 Station):	
	VQK
Phoenix Islands (3 Stations):	
Canton	ZIT
Hull	ZIT 23
Gardner	ZIT 25
Line Islands (2 Stations):	
Fanning	VQN 22
Christmas	VQN 23

Table E-2. Summary of Available Information on Transmitters at Tarawa.

Number On Hand	Type or Model	Manufacturer	Source	Input Power Required	Unmodulated Output Power to Antenna (Watts)	Antenna	Frequency Range		Usage
							(Megacycles)	(Kilocycles)	
2	AT14	T and S (Australian)	Purchased after World War II from Australian Air Force (wartime model)	240 volts AC 1-phase mains-operated	200	Hertz*	2 - 20	--	CW, MCW, voice
2	AT13	AWA (Australian)	Purchased in 1946 from Australian Air Force (wartime model)	--	200	Hertz*	2.5 - 20	--	MCW
1	12J50904	AWA (Australian)	Purchased in 1947 (postwar model)	--	500	Terminated "Y", directed at Fiji; 600-ohm twin feeder	2 - 20	--	CW, MCW, voice
1	1J51020	AWA (Australian)	Purchased in 1947 (postwar model)	240 volts AC 1-phase mains-operated	100	Long wire, horizontal	2 - 20	330 - 520	CW, MCW, voice, navigational aid**
1	--	Local engineers	Constructed at Tarawa in 1950	--	50	Top-loaded long wire, horizontal	--	844	Voice***
I	--	STC (Australian)	Being installed at end of 1959	AC 3-phase	2,500	Vertical incidence array (special high-angle radiation)	--	--	Voice****

T and S = Thom and Smith, Ltd.

AWA = Amalgamated Wireles Austrasia, Ltd.

STC = Standard Telephones and Cables, Ltd.

*Single-element, simple half-wave, horizontal Hertz antenna; delta-matched by a 600-ohm twin feeder and cut to proper length for the frequency used.

**Fitted with separate automatic keying unit, constructed at Tarawa, to transmit long dashes interspersed with identification "TW" as a navigational aid to aircraft in the Tarawa region.

***Used with locally constructed studio equipment.
****To be used with audio equipment manufactured by AWA (Australian) and PYE (English) and located in remote studios at Betio and the Information Office at Bairiki.

Table E-3. Summary of Available Information on Receivers at Tarawa

Number On Hand	Type or Model	Manufacturer	Source	Components	Input Power Required	Antenna	Usage
5	AMR type 680X	Eddystone (English)	--	13 tubes, a rectifier, and voltage stabilizer	240 volts AC mains-operated	Hertz doublet, shielded feed	MCW ¹
1	AMR type C13500	AWA (Australian)	Purchased from wartime disposals	9 tubes and rectifier	240 volts AC mains-operated	Hertz doublet, shielded feed	CW
1	type RA-1B	Bendix (American)	Purchased from wartime disposals	8 tubes and rectifier	240 volts AC mains-operated	Long wire, horizontal	CW, MCW

AWA = Amalgamated Wireless Austrasia, Ltd.

Table E-4. Summary of Available Information on Transmitter-Receiver at Tarawa

Number On Hand	Type or Model	Manufacturer	Input Power Required	Unmodulated Output Power to Antenna (Watts)	Antenna	Frequency Used (Megacycles)	Usage
1	FM type 30-SU-8C	Standard Telephones and Cables, Ltd. (Australian)	240 volts AC mains-operated	10	Ground plane mounted on mast 80 feet above surface of ground	74*	VHF FM voice**

* Same frequency used for both transmitting and receiving.

** Fitted with operator's control unit for two extensions at Betio, one to the public telephone booth at the Receiver Station and the other one to the District Office.

Table E-5. Test Equipment Used in Radio Workshop at Tarawa

Quantity	Equipment	Type or Model	Manufacturer	Testing Range
2	Multimeter	Model 8 Universal	Avo (English)	--
1	Multimeter	University type MVA/2	-- (Australian)	--
1	Insulation tester	Series 3	Megger (English)	--
1	Signal generator	Type E2	Advance (English)	100 - 100,000 kilocycles
1	Signal generator	Type A51948	AWA* (Australian)	VHF (fixed frequency)
1	Audio oscillator	RC generator GM 2315/02	Philips (Dutch)	20 - 20,000 cycles per second
1	Oscilloscope	GM 5655/02	Philips (Dutch)	--
1	Measuring bridge	Philoscop 11 type GM 4144/01	Philips (Dutch)	--
1	Valve voltmeter	Electronic testmeter Mk 4	Avo (English)	--
1	Valve tester	Type 160	Avo (English)	--
1	Testmeter	--	STC** (Australian)	VHF
1	Neutralizing meter	(for AWA transmitters)	AWA* (Australian)	--
1	Frequency meter	Model BC221-M	Bendix (American)	125 - 20,000 kilocycles

* Amalgamated Wireless Austrasia, Ltd.

** Standard Telephones and Cables, Ltd.

Table E-6. Equipment Usage at Tarawa in Point-to-Point Communications.

Station		Type of Signal	Transmission			Reception		
Location	Call Sign		Type of Transmitter	Frequency (Megacycles)		Type of Receiver	Frequency (Megacycles)	
				Day	Night		Day	Night
Gilbert Outer Islands	VSZ + suffix	MCW	AT14*	6.9875	--	C13500	7.460	3.730
Ellice Islands	ZJU + suffix	MCW	AT14*	6.9875	--	C13500	7.460	3.730
Ocean Island	VQK	MCW	AT13**	11	--	680X	7.490	--
Phoenix Islands	ZIT + suffix	MCW	AT13**	11	--	680X	9.825	--
Line Islands	VQN + suffix	MCW	AT14*	6.9875	6.9875	C13500	7.460	3.730
Suva	VPD	MCW	AT13**	11	--	680X	13.395	5.800
Honiara	VQJ	MCW	AT13**	11	--	680X	11.568	--
Nauru	VKT	MCW	AT13**	11	--	680X	8.175	8.175
Nadi	ZQD	MCW	AT13**	11	11	680X	11.450	9.400
Nadi	ZQD	MCW	12J50904	16.0775	--	680X	15.600	--
Bairiki***	VSZ	VHF FM voice	30-SU-8C	74	74	30-SU-8C	74	74
Bikenibeu***	VSZ	VHF FM voice	30-SU-8C	74	74	30-SU-8C	74	74

* Same transmitter.

** Same transmitter.

*** Intra-Tarawa communications.

Table E-7. Equipment Usage at Tarawa in Shore/Ship Communications

Station	Type of Signal	Transmission			Reception		
		Type of Transmitter	Frequency (Kilocycles)		Type of Receiver	Frequency (Kilocycles)	
			Day	Night		Day	Night
Colony ships, overseas ships in area, or as required	MCW, voice	AT14	8790.2 4413.8	-- 4413.8			
	CW, voice				680X	4108.4 2182	4108.4 2182
	CW				680X	6282	6282
Overseas ships (international distress frequencies)	CW, MCW	1J51020	500	500	RA-1B	500	500
			422	422		422	422
			410	410		410	410

Table E-8. Equipment Usage at Tarawa in Ground/Air Communications, Aircraft Navigational Aid, and Local Broadcasting Service

Station	Type of Signal	Transmission			Reception		
		Type of Transmitter	Frequency (Kilocycles)		Type of Receiver	Frequency (Kilocycles)	
			Day	Night		Day	Night
Ground/air: All aircraft in area	MCW, voice	AT14 or 1J51020	13344.5 8845.5	5641.5 2945	680X	13344.5 8845.5	5641.5 2945
Navigational Aid: All aircraft in area as required	CW*	1J51020	375	375			
Local Broadcasting: Gilbert and Ellice Islands	Voice**	AT14	6050	6050			
Tarawa	Voice***	Local****	844	844			

* Automatically keyed to send long dashes interspersed with identification "TW."

** Vernacular programs.

*** English-language programs.

**** Constructed by local engineers for low-power (50 watts) operation.

Table E-9. Tarawa Radio Schedules as of 1 September 1959

Time		Type of Schedule *	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
0600	1800	C	Open VHF, local, and overseas shipping watches	74000 4113 500	74000 4108 500
0600	1800	WX	ZJU 22, 23, and 26; VSZ 27, 31, and 32	6987.5	7460 3730
0600	1800	WX	VQK Ocean Island	11000	7490 3745
0600	1800	C	Special schedule for Bairiki, Bikenibeu (priority only) VHF	74000	74000
0615	1815	C	ZJU Ellice subs	6987.5	7460 3730
0620	1820	WX	ZQD Nadi	11000 16077.5	9400 11450
0700	1900	C	VSZ send traffic list and traffic to Ellice subs	6987.5	7460 3730
0705	1905	WX	ZQD Nadi if no contact at 0620M	11000	15600
0730	1930	C	ZPD Suva	11000	13395
0800	2000	C	Watch-keeping this area until 1000M		500
0800	2000	C	Colony shipping	4413.8	4108.4
0800	2000	C	Bairiki and Bikenibeu worked on 6987.5 kilo- cycles when ZJU Ellice clear (until 0845M), then VSZ changes to 4413.8 kilocycles. Bairiki and Bikenibeu keep continu- ous watch on VHF during office hours.	6987.5 4413.8	3502.5 74000
0830	2030	C	Bairiki, Bikenibeu Sundays and holidays only	4413.8	3502.5

* C Commercial communications

WX Weather information

Table E-9. Tarawa Radio Schedules (Cont'd)

Time		Type of Schedule*	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
0855	2055	WX	VQK Ocean Island, ZJU Funafuti, VSZ 31 Arorae	6987.5	7460
			VQK Ocean Island		7490
0900	2100	C	VQK Ocean Island listens on 11000 kilo- cycles until 1000M	11000	7490
0900	2100	WX	ZQD Nadi	11000	15600
0900	2100	C	VSZ sends shipping notes and traffic list to Northern Gilberts, sends and receives traffic until 1015M	6987.5	7460
0905	2105	C	ZIT Canton listens for VSZ on 11000 kilocycles until 1000M (Pass pri- ority Government and all private traffic for Christmas)	11000	9825
0915	2115	C	VPD Suva	11000	13395
0950	2150	C	VQJ Honiara (Sundays, holidays only priority traffic)	11000	11568
1015	2215	C	VSZ sends shipping notes and traffic list to Southern Gilberts, handles traffic until 1130M	6987.5	7460
1015	2215	WX	ZQD Nadi administra- tion	11000	15600
1030	2230	C	VKT Nauru	11000	8175
1050	2250	C	VQJ Honiara (except Sundays and holidays)	11000	11568

* C Commercial communications
WX Weather information

Table E-9. Tarawa Radio Schedules (Cont'd)

Time		Type of Schedule*	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
1100	2300	C	VQK Ocean Island listens for VSZ until 1200M (except Sundays)	11000	7490
1130	2330	C	VPD Suva	11000	13395
1130	2330	C	VSZ 31 Arorae accepts priority traffic for Ellice weather subs	6987.5	7460
1150	2350	WX	VSZ 31 Arorae passes Ellice weather to Tarawa	6987.5	7460
1155	2355	WX	VSZ 32 Butaritari	6987.5	7460
1200	2400	C	Bairiki, Bikenibeu Sundays and holidays	4413.8	3502.5
1200	2400	WX	VQK Ocean Island	11000	7490
1200	2400	C	Watch-keeping this area until 1400M		500
1200	2400	C	Tarawa sends traffic list and exchanges traffic with Northern Gilberts until 1445M	6987.5	7460
1205	0005	WX	ZQD Nadi	16077	15600
1300	0100	C	Tarawa keeps special schedule Colony ships (urgent traffic only)	4413.8	4108.4
1305	0105	WX	ZQD Nadi for area forecast	16077	15600
1400	0200	C	VKT Nauru (except Saturdays, Sundays, and holidays)	11000	8175
1445	0245	C	ZIT Canton keeps watch on Tarawa for traffic until 1545M	11000	9825

* C Commercial communications

WX Weather information

Table E-9. Tarawa Radio Schedules (Cont'd)

Time		Type of Schedule*	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
1445	0245	C	Tarawa works VQK on 6987.5 kilocycles until weather is collected at 1445M (except Sundays)	6987.5	7490
1455	0255	WX	Tarawa collects weather from Ocean, Funafuti, and Arorae	6987.5	7460
			VQK Ocean Island		7490
1500	0300	C	Tarawa sends traffic list and subs, receives traffic from Southern Gilberts until 1730M	6987.5	7460
1500	0300	C	VQK Ocean Island keeps listening watch on Tarawa for traffic until 1600M (except Sundays)	11000	7490
1510	0315	WX	ZQD Nadi	16077	15600
1530	0330	C	VPD Suva	11000	13395
1600	0400	C	Tarawa works Colony shipping	4413.8	4108.4
1600	0400	C	Watch-keeping this area until 1800M		500
1600	0400	C	VQJ Honiara (except Saturdays, Sundays, and holidays)	11000	11568
1630	0430	C	Bairiki, Bikenibeu	4413.8	3502.5
1645	0445	WX	VQD Nadi administration (except Sundays)	11000	15600
1700	0500	C	VQK Ocean Island keeps watch on Tarawa until 1800M	11000	7490
1730	0530	C	VPD Suva	11000	13395

* C Commercial communications
 WX Weather information

Table E-9. Tarawa Radio Schedules (Cont'd)

Time		Type of Schedule*	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
1800	0600	WX	Collection of subs weather until 1800M	6987.5	7460 3730
1800	0600	C	Special VHF schedule with Bairiki and Bikenibeu (urgent or priority traffic only)	74000	74000
1820	0620	WX	ZQD Nadi	11000	9400
1830	0630	C	VQN 23 Christmas Island	6987.5	7460 3730
1830	0630	C	ZIT Canton Island keeps listening watch for traffic until 1930M	11000	9825 7460
1900	0700	C	VPD Suva	11000	13395
1930	0730	C	ZJU Funafuti	6987.5	7460 3730
1945	0745	C	VKT Nauru (except Saturdays, Sundays, and holidays)	4413.8	8175
2000	0800	C	Watch-keeping this area until 2200M		500
2000	0800	C	Special VHF schedule with Bairiki and Bikenibeu (urgent or priority traffic only)	74000	74000
2000	0800	C	VQK Ocean Island keeps listening watch until 2200M	11000 6987.5	7490 3745
2200	1000	C	Special VHF schedule with Bairiki and Bikenibeu (urgent or priority traffic only)	74000	74000
2340	1140	WX	ZJU 26 Niulakita	6987.5	7460 3730

* C Commercial communications
 WX Weather information

Table E-9. Tarawa Radio Schedules (Cont'd)

Time		Type of Schedule*	Station	Frequency Used by Tarawa (Kilocycles)	
Local (M Zone)	Greenwich Mean			Transmission	Reception
2345	1145	WX	Collection of weather from subs, including ZIT 25 Gardner Island	6987.5	7460 3730
2345	1145	WX	Collection of weather from VQK Ocean Island	6987.5	7490 3745
2400	1200	WX	ZQD Nadi	4413.8	9400

* C Commercial communications
 WX Weather information

ATOLL RESEARCH BULLETIN

No. 73

Some aspects of agriculture on Tarawa Atoll, Gilbert Islands

by

R. R. Mason

Issued by

THE PACIFIC SCIENCE BOARD

National Academy of Sciences--National Research Council

Washington, D. C.

October 15, 1960

CONTENTS

	Page
Introduction	1
Soils of Tarawa	2
Water	8
Gardening experiments	11
Livestock	13
Tools	14
Improvements possible in the native agriculture	15

DIAGRAMS

1. Soil types in the Bikenibeu area
2. Water levels in the Bikenibeu wells
3. Salinity of water near Bikenibeu
4. Air and earth temperatures and relative humidity

Some aspects of agriculture on Tarawa Atoll,

Gilbert Islands

by

R. R. Mason

INTRODUCTION

The following paper is part of a report written in 1951 which has not previously been published. The writer spent three months on Tarawa taking part in the South Pacific Commission's project E.6, the economic development of coral atolls. The report of Dr. R. Catala,* the leader of the S.P.C. team, has been published (Atoll Res. Bull. 59: 1957).

It had been intended to visit two or three other islands after completing investigations on Tarawa; but shortage of transport made it necessary to return to Fiji when an opportunity offered, before any other islands could be visited.

Work accomplished includes soil and water investigations, studies on the main crops* (coconuts, Cyrtosperma, pandanus, etc.), observations on livestock, and some brief notes on tools and on native plants.* Consideration was given to the establishment of a small agricultural station at Bikenibeu, near the site chosen for the King George V school.

* The published report by Dr. Catala incorporated parts of the observations made on Tarawa by Mr. Mason and treated some of the same subjects. To avoid costly duplication of material, some chapters of Mr. Mason's report are omitted from this Bulletin. The report of Dr. Catala also contains many photos which illustrate points brought out by Mr. Mason.--Ed.

SOILS OF TARAWA

Since all the soils of Tarawa Atoll are derived from coral, there is no great variation. Hard coral rock outcrops in a few places, and in others there is little or no sand but many stones--for example, at Temaiku. In general, however, there is a layer of sand two to six feet deep above the underlying coral rock. Where soil has been developed, the commonest profile is a horizon of brown to dark brown sandy material high in organic matter and from 2 to 12 inches deep, overlying a pale brown horizon extending to between 12 and 30 inches; below this is coarse yellowish-white sand. This soil type has been named the Bikenibeu Sand ("B"); 17 profiles were examined and some are described below.

Two phases of this soil type were met fairly frequently. They are the Bikenibeu Sand Shallow Phase ("Bsh"), in which hard coral rock is found at 36 inches or less; and the Bikenibeu Sand Stony Phase ("Bst"), with a stony layer, often closely packed, usually at about twelve inches. Nine profiles of these two phases were examined.

The Eita Marine Marsh ("E") is a soil type in which extreme salinity inhibits plant growth. The type occurs infrequently in depressions behind the ocean and lagoon beaches.

The Mweang skeletal soil ("M") shows a dark-brown or black peaty sand in the upper layers, associated with large numbers of small stones, the soil occupying the interstices between the stones. Three profiles were examined, in separate areas. The dark-coloured soil, if sieved free from stones, is useful for gardening.

The fourth soil type is the Te Ribu loamy sand ("R"), which again was found in small isolated areas. The loamy sand characteristic of this soil type is found at a variable depth, never on the surface, although at Buota it was uncovered at the bottom of 'babai' pits. It is sufficiently plastic to be moulded in the fingers. This soil appears to be very poor, for the coconuts at Buota were few in number and were yellow with little fruit, and there was no grass. In the pits the 'babai' was poor and yellowish except for a few plants growing in a shaded place. Shade however was very limited. A similar condition, though not so pronounced, was seen near Buariki.

The rapid variation of soil type and the consequent impracticability of preparing soil maps is shown by figure 1, a plan giving the different types in the Bikenibeu area.

Apart from the exceptions mentioned above, there was little correlation between soil type and plant growth. No correlation was observed between production of coconuts and depth of dark soil except when the latter was less than two inches. On the other hand, profile No. 4 was from an area where the trees were distinctly above average, and it showed the horizons at 4 and 8 inches only, with maximum root development between 12 and 18 inches. The only places where fertility was markedly higher were on a deep dark-coloured soil at Buariki, where the rainfall is probably a little higher, and on Betio. Pre-war Betio is said to have been no different from the other islets, but now the difference is great.

A young coconut, not more than 5 years old but already starting to flower was typical of many. The creeper Ipomea pes-caprae was running riot in places. The increased fertility is the result of the intense disturbance of the ground by bombs and shells in 1944, and of the many thousands of Japanese buried there. Many plants not seen elsewhere flourish there despite the lack of shade. As a result of the bombardment, there were only about twenty mature coconut trees left on the whole islet after the war.

The underlying coral rock was not often reached in digging pits, but was quite frequently seen in village wells. (Profiles could not be taken since the sides are built up with stone). A very hard layer was reached in Well No. II at Bikenibeu at 99 inches. This appeared to be very thick, although several wells were seen where it was only 3 to 4 inches. Its porosity was shown by the water rising through it with the rising tide. A series of borings with a post-hold borer showed the varying depths in a cross section of the island east of the village of Bikenibeu. The rock is prominent at that place on both the lagoon and ocean shores. On the lagoon side of the island ('Tanrio') the depth was about 3 feet near to the road, twenty yards from the sea. Trees were bearing fairly well in all three places. Presumably the root system was sufficiently long to reach the deeper soil. (Many roots were encountered while digging well No. IV at Bikenibeu although no trees grew within 10 yards.)

Outcrops of rock occur near Eita village and on the small peninsula at Temaiku. No coconuts grew in the former place; but in the latter, fruit was produced to a limited extent even where there was 4 inches or less of sand over the rock. Presumably cracks exist. East of Abatao is an area of fairly hard stone, but a pit showed extensive coconut roots underneath, at 6 to 10 inches depth. This is not coral but appears to be a type of mudstone which has hardened on exposure.

Soil samples collected in Tarawa and despatched to Suva for analysis were all ruined by sea water while in the hold of R.C.S. "Kiakia," together with most of the entomological specimens. The following ten analyses were made in Tarawa, using the 'La Motte' apparatus. (Table 1, p.4)

These samples were taken where the soil by its blackness or the coconuts by their fruit appeared above average.

Native names for different kinds of sand and soil are as follows:

Te Bike	Shore sand
Te Tano	Ordinary sandy soil
Te Bon, Te Bon Ro, Te Iarauri	Black soil, frequently found under 'Te Uri' (Guettarda)
Te Mweang	Light black soil which blows in the wind.
Te Ribu, Te Riburibu	Grey clayey soil. Worse than sand if water is salty.
Te Ririba	Outcrops of rock
Te Bokaboka	Mud in babai pits etc.

TABLE NO. 1

Soil Type	Profile No.	Depth in inches	Soil description	p H	Nitrate Nitrogen (p.p.m.)	K m.e per 100 gms	P ₂ O ₅
M	29	0-12	Black peaty soil between stones	7.6	4	3.0	0.023
M	30	0-6	Representative sample of area	8.0	12	3.0	0.020
R	32	1-3	Brown, very sandy	8.2		2.5	0.003
	"	20-24	Dark brown former surface	7.8			
	"	60	Grey, clayey, slightly sticky				
B	8	0-8	Black, high organic matter	8.0		2.5	0.011
	"	8-18	Dark, less organic matter	8.2			
	"	84	Whitish coarse sand	8.2			
B	8	0-6	Representative sample of area	8.0	6	2.7	0.017
B	6	0-6	Dark brown sand	8.0	30	3.0	0.009

*

Author did not state what units the P₂O₅ figures represent.--Ed.

Description of Soil Profiles

Soil types:	Bikenibeu sand	B
	Bikenibeu sand Shallow phase	BsL
	Bikenibeu sand Stony phase	Bst
	Eita marine marsh	E
	Te Mweang	M
	Te Ripu	R

No structure was observed in any of these soil types.

BIKENIBEU SAND (B)

Profile No. 6: Tabaongo, $1\frac{1}{4}$ miles east of Bikenibeu wells

Surface: Coconuts with patches of Lepturus

1. 0 to 2 inches Dark brown sand, friable, organic-matter-stained, free draining, few roots, no stones.
2. 2 to 54 inches Pale brown sand, loose, no organic matter free draining, root development greatest between 6 and 18 inches with some to 36 inches. No stones.
3. 54 to 69 inches Pale yellow sand, loose, no organic matter free draining, no roots, coral fragments up to 2 inches in size.
4. 69 + inches Hard coral rock.
Water rises to 66 inches at high water only.

This is the commonest type of profile. Considerable variation occurs in the extent of the horizons. Horizon I sometimes extends to 5 inches, while horizon 3 was sometimes met as high as 10 inches. Less developed profiles occur particularly near the beaches. Occasionally a buried former surface is met. In places where the coral rock was not reached by about 6 feet, further digging was prevented by water.

BIKENIBEU SAND, SHALLOW PHASE

(B sL)

Profile No. 18

Surface: Coconut palms, germinating nuts; fallen leaves, no grass.

1. 0 to 10 inches Brown sand, friable, organic-matter stained, free draining. Maximum root growth between 3 and 9 inches. No stones.
2. 10 to 20 inches Yellow coarse sand, loose, no organic-matter, free draining. Few roots, no stones.
3. 20 + inches Hard coral rock.

In other profiles horizon 1 varies from 2 to 12 inches and from brown to dark brown. In the other pits examined, the hard coral was struck at depths between 27 and 38 inches. It was too hard to be broken by crow-bar.

BIKENIBEU SAND, STONY PHASE

(B st)

Profile No. 25, 3/4 mile east of Bikenibeu.

Surface: Coconut palms rather yellow, yield fair to poor. No other vegetation.

1. 0 to 2 inches Brown sand, friable, organic-matter stained, free draining, few roots, no stones.
2. 2 to 15 inches Pale grey-brown sand, loose, no organic-matter, free draining, root development throughout; no stones.
3. 15 + inches Stones - irregular flat coral stones lying horizontally and too tightly packed to prise with spade without great difficulty.

The thickness of the stony layer is variable. In profile 26, at the old site of Eita village, a layer of flat very hard white smooth coral stones up to 12 inches long and $1\frac{1}{2}$ inches thick occurs between 14 and 16 inches. Below this occurs a horizon of yellow and brown very coarse sand with few roots but with many stones.

EITA MARINE MARSH
(E)

Profile No. 27: salt bog 22 yards inland from ocean beach, with high sand bank intervening. Due south of Te Bike island.

Surface: bare of vegetation; greenish-brown in colour.

1. 0 to 3 inches Pale grey sand
2. 0 to 10 inches Grey sand
3. 10 + Yellow coarse sand

Brackish water was struck at 7 inches but later it rose to 1 inch, and probably covers the surface at high water spring tides. Salt content very high - approximately 1.98% chloride. Typical of numbers of small isolated areas close to the sea where fluctuations of salty water associated with tidal rise and fall inhibits growth of vegetation.

TE MWEANG
(M)

Profile No. 28, south of Taborio village.

Surface: Vegetation cover of coconuts, sparse Lepturus, and some shrubs. Ground surface comprises white coral pebbles.

1. 0 to 14+inches Black highly organic sand occupying the interstices between the closely packed stones, free draining, roots throughout, extremely stony.

The highly-packed stones make digging almost impossible. One pit near Abatao, however, penetrated the upper horizons and reached off-white sand with many larger stones at 18 inches.

It would appear that the reason for the striking accumulation of organic matter in this soil type is that all root growth is confined to the very small volume of soil between the stones; thus the continuing addition of organic matter to the soil balances the losses through oxidation.

TE RIPU
(R)

Profile No. 32: near Buota

Surface: Coconuts unhealthy in appearance, yellowish and with few nuts. No grass cover. Cyperus, Sida, Pandanus, Scaevola occur close by, Guetarda scrub being dominant at this spot.

1. 0 to 10 inches Dark, nearly black loamy sand, friable, organic-matter stained, few roots, no stones.
2. 10 to 30 inches Grey fine sandy loam, slightly sticky when wet, no organic matter, no roots, no stones.
3. 30 + inches Mixed coral fragments.

WATER

Water is very frequently the limiting factor for growth. The rainfall is extraordinarily variable.* In 1930, 138.52 inches fell, 29 inches being in November. (These figures are by courtesy of the New Zealand Meteorological Service and the Gilbert and Ellice Administration.) In 1950 a total of 15.38 inches fell in twelve months - 2.94 inches in the first seven months. (Rainfall is high in the northern islands and lower in the south; in 1950 Beru, one of the southern islands, received 9.68 inches.) The mean for Tarawa over 16 years is 64.19 inches per annum. Naturally last year's drought (1950) killed off numbers of coconuts in poor environments such as on sand spits or on small islands. It seems remarkable that anything could stay alive.

Ground-water can be obtained anywhere that a hole can be dug to a depth of from five to ten feet, depending on the height of the land. Drinking water is obtained from wells of low salinity. It appears that the level of well water varies only slightly with conditions of rainfall but no definite data could be obtained on this subject. (A recording device was designed but was not completed before leaving.) There is a very pronounced rise and fall of ground-water due to the effect of the tides. Naturally the movement is greatest close to the beach and least in the centre of the island. Nine wells were dug at Bikenibeu on a line at right angles to the beaches, to give a transverse section of the land, and the levels in these were recorded over a 36 hour period. Graphs from the data obtained are shown in Figure 2. Since all nine could not be plotted on the same axes, the first five and the last four are given separately. The sites of the wells are shown in Figure 3; well No. 1 is nearest to the ocean beach, and well No. 9 is on the lagoon tidal sand flats. The graphs are plotted about a common mean, and show clearly how the movement decreased from No. 1 to No. 5 and increases again from No. 6 to No. 9 though with less regularity. It is also clearly shown

* Rainfall tables are included in Atoll Res. Bull. 60: 1957, by M.-H. Sachet.--Ed.

FIGURE NO. 1

SOIL TYPES
IN THE
BIKENIBEU AREA.

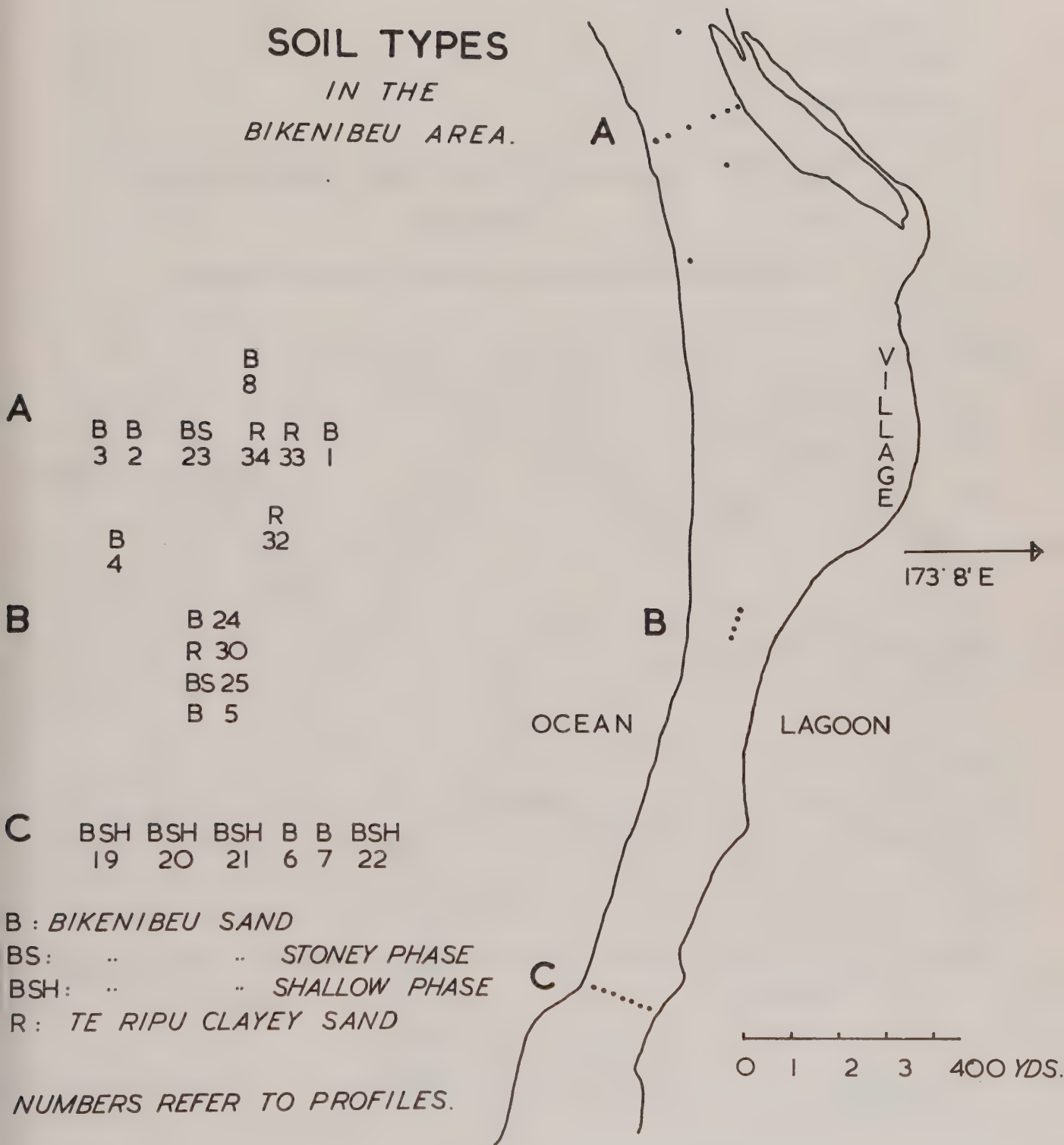


FIGURE No. 2

WATER LEVELS IN THE BIKENIBEU WELLS

RECORDED IN INCHES OVER A 36 HOUR PERIOD.

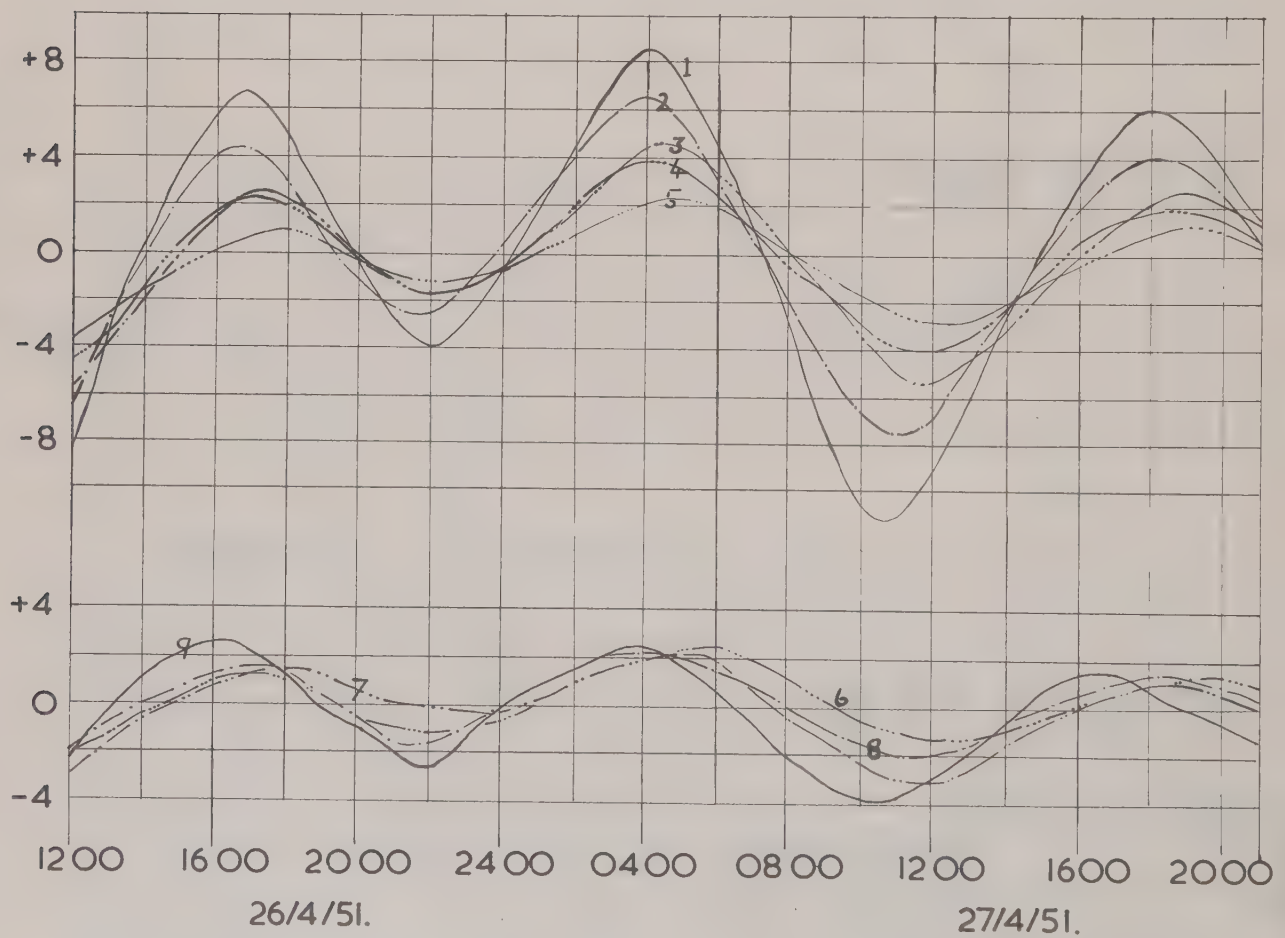


FIGURE No. 3

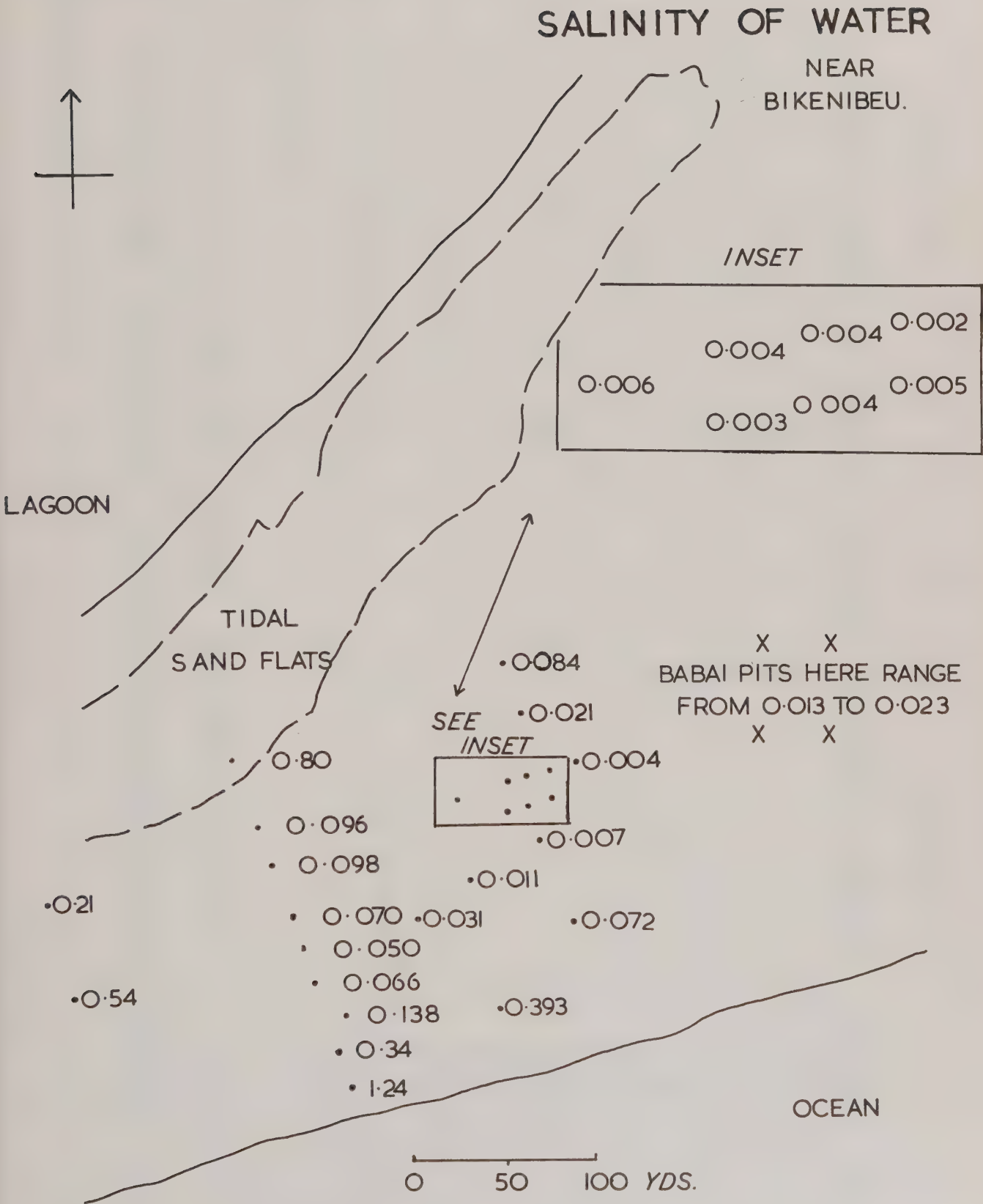
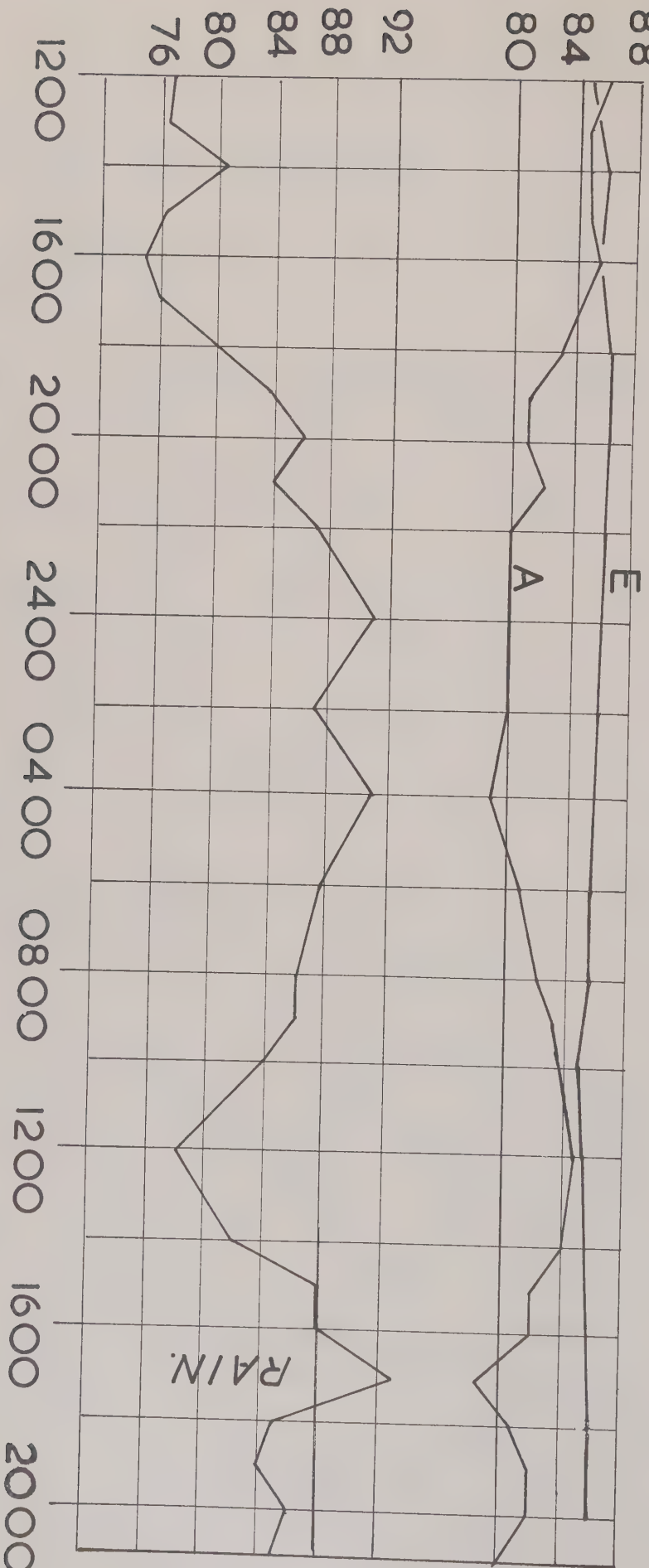


FIGURE No 4

AIR & EARTH TEMPERATURES AND RELATIVE HUMIDITY.

DEGREES FAHR.



26/4/51.

27/4/51.

that the central wells reach their maxima and minima one and half to two hours later than the one nearest to the beach, although there are some peculiar irregularities.

There is a very great variation in the salinity of ground water even within a short distance. Figure 3 shows the salinity (expressed as percentage of chloride) in a number of samples near Bikenibeu. The analysis was carried out by silver chloride titration. In little over 100 yards in a transverse direction, salinity fell from 1.24 percent to 0.066 percent Cl. This decrease of salinity from the beaches to the centre of the island is normal. Variations also occur in a longitudinal direction for example, from 0.070 percent to 0.011 percent in two hundred yards. Water from well No. 3, having a salinity of 0.138 percent Cl was unfit for drinking or washing. Well No. 5, at 0.050, was all right for washing, but unpleasant to drink, while water from the best source, 0.002 percent Cl, was indistinguishable from fresh water. Most wells are presumably sited by guess; and a preliminary survey would obviously be of great value when a new one is to be built.

Salinity also varies with time, due to rainfall and evaporation. Wells which are normally sweet became brackish in the drought of 1950. The following table shows the variation of one well at intervals of a few days, with the amount of rain recorded in the intervening periods.

TABLE NO. 2

Variation of salinity in well No. 6 at Bikenibeu		
Date	Percentage Chloride	Rainfall between analyses (in inches)
April 26	0.054	
1951 28	0.047	0.965
30	0.044	0.375
May 1	0.025	0.16
4	0.029	0.76
8	0.024	1.72
9	0.024	0.14
12	0.028	0.01

The extent of the variation appears to vary from place to place, shown by Table No. 3 which gives the analyses of the nine wells on two different days. The tendency appears to be for the most saline wells to fluctuate most.

TABLE NO. 3

Salinity of the Bikenibeu wells on two dates
(expressed as percentage of chloride)

Well No.	<u>Date of Sampling:</u>		Percentage Reduction:
	6-April-51	12-May-51	
1	0.93	0.526	43.4
2	0.42	0.288	31.4
3	0.15	0.163	- 8.6
4	0.054	0.040	25.9
5	0.073	0.070	4.1
6	0.070	0.028	60.0
7	0.104	0.068	34.6
8	0.105	0.076	27.6
9	0.585	0.208	64.4

Plants differ very greatly in their tolerance of salinity, mangrove obviously being the most tolerant since it grows in sea water. "Te Ngea" (*Pemphis acidula*), a saltbush with very hard wood, grows very close to the water, mainly on the lagoon shore, and the two shrubs "Te Mao" (*Scaevola sericea*) and "Te Ren" (*Tournefortia argentea*) grow everywhere, even on the beach crest on the ocean side where they are exposed to salt spray. "Te Uri", another shrub or small tree (*Guettarda speciosa*) is slightly less tolerant, as dead plants can frequently be seen on the beach crest; however, many seemingly-dead trees sprout again from the base of the trunk. "Te Itai" (*Calophyllum inophyllum*) is a hard wood often growing close to the water on the lagoon shore. Coconuts and *Pandanus* both grow fairly close to the sea but not as close as any of the foregoing plants. As mentioned earlier, many coconuts growing on small islets or on narrow promontaries were killed in the 1950 drought. At Bikenibeu, healthy coconuts were growing on the ocean side of the first well which on analysis after a fairly dry period showed 1.24 per cent of chloride. Table No. 2 however, shows that this high figure is not constant. The first effect of severe drought is to reduce the size of the young leaves of coconut palms growing under hard conditions; this results in a typical

flat-topped appearance. Trees were seen at Temaiku which had been severely affected and which were just starting to grow normally again.

Introduced flowering trees and others are frequently seen in the villages, which are all on the lagoon side. For example, at Marenanuka, Frangipani and Oleander were growing and flowering on a somewhat restricted scale, setting few seeds. These trees were near a well in which the water contained 0.042 per cent of chloride, a fairly low figure. Breadfruit trees in the same area were healthy, though in most villages individual trees here and there had been killed off by drought.

GARDENING EXPERIMENTS

With the exception of kumala (sweet potato) cultivation, such as at Buota and Betio (in occasional patches) gardening is confined to Europeans, who frequently bring soil into the Colony and grow plants in drums with some success. Selected black soil also gives good results especially if enriched with compost; but the effect of added organic matter such as leaves, manure, and fish offal appears to be confined to the first or first two crops only. Excellent tomatoes, China cabbage, English cabbage and water melons were seen on such selected soil (grown by Mr. Carter at Bonriki). Lettuce can also be grown. Frequent watering with good water is of course necessary. Pumpkins will grow in ordinary good soil. A climbing bean (Dolichos lablab) at Betio was seen which spread over the roof of a house, yielding well; but another at Bonriki in prepared soil suffered severely from chlorosis and yielded no fruit.

Seeds were taken from Fiji in the hope of establishing a leguminous cover but results were disappointing. In the first nursery, a good site was selected by Dr. Catala to the west of the Bikinibeu house and natural conditions were observed - no watering or manuring was given, but the rainfall after sowing was good.

Sown 24 March 1951:

Leucaena glauca - 'vaivai' - grew rapidly at first, slowing down later - 3 to 4 inches in two months. Slight paleness shown after one month. Likely to persist.

Centrosema pubescens - Never advanced beyond cotyledonary leaves.

Calopogonium mucunoides - First true leaves were yellow and soon died, the cotyledons persisting for some time before dying.

Sown 27 March 1951:

Cajanus indicus - Pigeon Pea - Died after producing two or three leaves. One only still persisted after two months.

Desmanthus virgatus - Appeared yellow and grew extremely slowly.

Pueraria phaseoloides - Hawaiian Puero - 4 or 5 seedlings only. Given soil from near Puero roots at Sigatoka Agricultural Station, Fiji. One grew very well until checked by the attack of a leaf-cutting bee; the others small but of a fairly good colour. Hopeful.

Stylosanthes guianensis - Growth stopped after 1 to 2 inches. Yellow.

Panicum maximum - Guinea grass from Sigatoka Agricultural Station. A few plants germinated after a month and had reached 2 inches by June.

P. maximum var. coloratum - Purple Guinea. Grew rather better than the common guinea grass, but neither is expected to survive.

Sorghum verticelliflorum - Kavirondo Sorghum. Whitish yellow - stopped growth at 6 inches.

Canavalia ensiformis - Sword bean. Rapid growth after germination followed by dying-off of the growing point in every plant except one.

Rice Bean - yellow leaves, but still growing after 5 weeks. (Very thickly planted). Growth appeared to be stopping at 2 inches.

Pawpaws and water melon were also sown for the sake of comparison; the pawpaws made slow growth but the melon seedlings died off.

Later sowings by Dr. Catala on 24 April 1951 were also disappointing.

A second nursery was made to the east of the house at Bikinibeu and different treatments applied. Calopo, Vaivai, Pigeon Pea and Kavirodono Sorghum were sown in 4 parallel beds which were divided into 8 sections by divisions at right angles to the lengths of the beds. Soil from corresponding legume roots in Fiji was applied to half of the plots of each of the three legumes.

Each group of 4 plots was then given 4 treatments as follows:

- (1) an NPK mixture: sulphate of ammonia, muriate of potash and super phosphate;
- (2) a solution of trace elements, including iron, manganese, magnesium, copper, zinc, molybdenum and boron;
- (3) Coconut meal. Application of this was delayed until early May as a result of its being misplaced on the ship.
- (4) Control.

The seeds were sown thinly and the seedlings were watered twice in their early stages.

The legume soil benefitted the Pigeon Pea but not the other legumes. Where it was applied, the Pigeon Pea had reached 2 feet and was still growing at the end of May, although attacked by the leaf eating bee. The untreated plants had mainly died out.

The NPK manures gave no effect.

The trace elements gave a slight response on the Kavirondo Sorghum - slightly better growth with a better colour.

The coconut meal had insufficient time to give results by the end of May

The calopo in this nursery reached the 2nd and 3rd leaf stages, but these leaves were very pale. The Leucaena grew as in the first nursery. The Pigeon Pea looked as if it might reach maturity where it had received a sprinkling of soil. The Kavirondo Sorghum was a better colour than in the first nursery but was decidedly yellow. However, it appeared to be still growing at 8 to 10 inches.

The results obtained from the nurseries are mainly negative but are nevertheless very interesting. It remains to be seen whether the Leucaena will become established. Greater response to the trace elements had been anticipated. The delayed application of coconut meal was unfortunate because it seems likely that it may have considerable effect over a period of time.

LIVESTOCK

Pigs are kept by the majority of householders in the villages. Most of the pens, which are usually just behind the village, are simply four pieces of Airstrip matting forming a square. Higher walls of two sections are not usual. The alternative to these iron strips is a wall of interlaced coconut trunks. Pens are usually in the shade; shelter is usually provided (by plaited coconut leaf) if they are in the open.

The pigs are of varied breeding; the only definite statement that can be made is that no Tamworth influence was seen. All are small. This is not entirely due to nutritional deficiencies as a boar imported from Fiji and his offspring are noticeably bigger than average. The most frequent type is a porker weighing up to 200 lbs. at a year or so; but unfortunately no details could be gathered as no pigs of known age were found. The people simply do not know. Interest in breeding is very low; boars were seen which were no more than 50 lbs. in weight - little runts not much bigger than a decent-sized weaner. On the other hand, a son of the Fiji-bred boar mentioned above (which was imported by the Catholic Mission at Teoraereke 4 years ago), was seen at Buariki. This pig was about 2 years old, well grown and much above the average for Tarawa. It was recently castrated because it got out of its pen and caused trouble; so it is now being fattened up. It was less trouble to castrate it than to make a strong pen. When the people in this village were asked if, supposing a good boar was available, they would pay one shilling service fee, they suggested giving half the litter at birth to the owner of the boar instead.

Litter sizes appear to be very small and the average number reared is probably only about three. Nutrition is almost certainly the limiting factor. Feeding does not vary greatly; indeed, it cannot, so limited are the foods. They comprise coconuts, herbs, and fish bones. Two to five coconuts are fed either once or twice a day. The common method is to feed once a day, giving water in the evening. The two small herbs 'Te Mtea' and 'Te Wao' (Portulaca lutea and Sesuvium portulacastrum) are commonly gathered by the children. Both are plentiful. Grass and babai leaves may

also be given, and possibly 'Te Bero' (Ficus sp.). Some people give toddy - presumably what is left over from their personal requirements.

Emaciated pigs were seen which were neglected by their owners and not fed regularly. Also one gilt was seen which had the same food as another, neighbouring, fat sow, but apparently this one could not digest coconut, and so was very thin. The gilt was little more than 50 lbs. and had one pig of about 25 lbs. The fat sow had had three litters; six in the first all died in a week, nine in the second all died in five days, and one was reared out of seven in the third litter.

In Eita village there were 12 gilts and sows, 2 boars, 10 weaners and porkers, and about 6 young pigs running loose. In Bikinibeu there were 18 gilts and sows, 2 boars, 9 weaners and porkers, and about 14 young pigs. (Both villages have populations of 124).

Paralysis of the hind quarters was seen in one sow, which had full use of its forelegs. One sow was seen with a swelling of the udder. Slow growth of some pigs was presumed to be due to worms. Lice were reported but not seen.

The listlessness of the people regarding pig husbandry and the unavailability of feeding stuffs to give a balanced ration combine to make significant improvement in pork production unlikely.

POULTRY

The majority of birds run loose in the villages, but sometimes fowl runs are seen, made of 'Te Ba' (coconut mid-ribs, which are 8 to 10 feet long). There is a great variation in breed and size, ranging from well-bred Rhode Island Reds kept by various European houses on Bairiki (such as the Residency), down to bush fowls weighing only a pound or two. Occasionally good looking birds are seen in the villages, and some birds live wild in the bush.

Their food is mainly coconuts, with what else they can forage. At the mission at Teaoaraereke, a big increase in egg production following the feeding of fish was mentioned. This indicates that considerable increases in poultry production should not be difficult to achieve.

Ducks are not very common, but some Muscovies were seen, one with a very good brood of ducklings.

No geese were seen.

TOOLS

Tools used in agriculture are very few and very simple. For cutting the many coconut roots which are in the soil everywhere, a spade with a circular blade is preferred. The blade is flat, and about 6 inches in diameter. The handle is commonly 5 feet of 3/4 inch pipe, which gives momentum to a cutting stroke. This spade, 'Te Rereba', is mainly used for digging or extending 'babai' pits.

Just as a Fijian is not often without his cane knife, so a Gilbertese usually has a machete type of knife, which is used for opening drinking nuts, cutting copra, and so on.

A mallet, 'Te Ikuiku' is made out of 'Te Ngea', a hard wood shrub (Pemphis acidula). Such mallets are used for beating flat the mid-ribs of pandanus leaves.

Other domestic tools are coconut scrapers (similar to those in Fiji) and scrapers for pandanus fruit. There are of course various articles for fishing, ranging from canoes down to fishhooks.

IMPROVEMENTS POSSIBLE IN THE NATIVE AGRICULTURE AND PROBLEMS REQUIRING FURTHER INVESTIGATION

The subjects requiring investigation are divisible into the problem of increasing exports, which means increasing copra production ; and the problem of increasing food production in order to provide for the increasing population, to lessen the dependence on overseas supplies, and to give a more varied diet..

An immediate improvement is possible in the quality of copra by reducing the interval between cutting and drying, and by taking more care during drying. At present, the coconut owners spend a day cutting copra and bring the wet copra back to the village for drying next day - an interval of up to 24 hours. To produce white copra, this interval should be reduced to less than 4 hours. To prevent contamination with sand and dirt, and to speed the drying process, drying trays should be erected above ground level, and should be provided with movable covers of galvanised iron or other rain-proof material.

The use of hot-air driers, for the production of good quality copra even in rainy weather, should be investigated. However, care is needed to prevent a trade developing in green copra between growers and Co-operative Societies, as this would inevitably cause delayed drying and consequent reduction in quality.

To encourage the production of better quality copra it will be necessary to introduce a grading system* coupled with reasonable price differentials between grades. Particular attention should be paid to thorough drying of copra. Encouragement of half-nut copra (obtained by husking prior to splitting, instead of by extraction using a knife) would result in less fragmentation and less dust, and probably higher oil content; but a longer drying period is needed. Finally, quality should not be lost during storage by allowing insect infestations to develop; a routine spraying of the sheds is recommended.

Management of the coconut groves could with certainty be improved by weeding the bushes and germinating nuts, by removal of aged and non-producing palms, and by a prohibition on burning within the groves.

* Copra grading was instituted in 1957.

It is highly probable that increased yields would also result from selective thinning in most places, and by the establishment of a leguminous ground cover; but these should be investigated before being advocated on a wide scale. The cover crops Calopo and Centro were unsuccessful at Bikenibeu but the beach pea Vigna marina, which flourishes on Funafuti is more likely to be suitable. There is insufficient evidence on which to base a firm recommendation for optimum spacing, but it appears that ten yards is too wide and gives insufficient ground shade. Eight yards triangular planting is tentatively suggested.

Very considerable losses occur in certain places through delayed collection and incomplete collection of nuts, resulting in partial or total losses through germination of the nuts. This problem is economic rather than agricultural, and is related to the problem of better utilisation of land held by absentee owners. A possibility worth investigation is the alteration of the export tax on copra into a land tax. This is considered possible since an overwhelming proportion of the land is used for coconut production. It would be necessary either for the tax rate to vary with the year's productivity, which depends on the rainfall or that there should be a flat rate with a reduction in drought years. It might also be necessary to reduce the rate in infertile areas.

The most important long-term measure in improving the crop lies in better planting of better nuts on unplanted land. No areas were seen on Tarawa which require felling and replanting, and it is not known if this would be justified on other islands. Selection of seed nuts of good shape from high yielding trees followed by rigorous selection of seedlings would not be difficult to carry out, but does not appear to have been thought of.

Recent figures for copra produced by the Gilbertese may be mentioned here. They are from the Colony copra Board's Annual Report for the year ending 31st March, 1958:

1951	1952	1953	1954	1955	1956 (drought)
4,019	3,956	7,705	5,770	7,180	2,900 tons.

It is certain that more 'babai' could be grown, mainly by greater attention to the existing area. Yields under different methods of management require study. For example, the pig manure is all wasted. The legume Gliricidia grows on Betio and Bairiki and could possibly be grown round the banks of pits, and used for mulching together with the pig manure. Varietal differences such as salt toleration, rate of growth, and yield are unknown. A comparison of the yields of Colocasia and the two main Cyrtosperma varieties 'Te Katutu' and 'Te Ikaraoi' over different intervals of time would be very interesting. Finally, a method is required to encourage the sale of 'babai' through the Co-operative Society to the people on Bairiki and Betio.

A point scarcely agricultural yet not out of place here concerns the use which might be made of mangrove; considerable protection could be given to the road where it crosses between islets by judicious planting of seedlings. The first stage of land reclamation on the lagoon shore could be construction of fish ponds, their banks being protected by mangrove.

Little improvement in pig keeping is possible without a big increase in interest among the owners. Selective breeding following the use of good imported boars could give big results if combined with better feeding standards. It is certain that a considerable amount of fish is necessary in the ration. Because of the difficulties of feeding, it is unlikely that pig keeping will ever get out of the "backyard" stage.

The poultry are probably well adapted to a frugal life and again, breeding for better size and egg laying could not be successful unless accompanied by better feeding, which however presents no great difficulty on a small scale.

No geese were seen; it is suggested that they should be tried, for they could make good use of the grass where it grows well, and provide animal protein to the human diet. Provision of grazing for them would also benefit the coconuts.

Many of the problems mentioned above could be studied on a small station, provided that appropriate personnel were available. The area around the house built at Bikenibeu is considered to be sufficiently typical. A plant introduction garden could be located near the fresh-water well. About 15 acres would suffice in the first instance.

In conclusion, I wish to acknowledge with gratitude the help given by His Honour the Resident Commissioner, the Director of Education, and many other officers of Government, and by Chief Kaubure Taniera and Assistant Master Toki.

ATOLL RESEARCH BULLETIN

No. 74

Birds of the Gilbert and Ellice Islands Colony

by

Peter Child

Issued by

THE PACIFIC SCIENCE BOARD

National Academy of Sciences--National Research Council

Washington, D. C.

October 15, 1960

CONTENTS

	Page
Introduction	1
Part A: Resident Birds	4
I. Sternidae (Terns and Noddies)	4
II. Sulidae (Gannets or Boobies)	12
III. Fregatidae (Frigate-birds)	14
IV. Phaethontidae (Tropic-birds or Bo'sun birds)	16
V. Procellariidae (Shearwaters and Petrels)	18
VI. Ardeidae (Hérons)	21
VII. Columbidae (Pigeons and Doves)	22
VIII. Phasianidae (Quails and Pheasants)	23
IX. Sylviidae (Warblers)	24
X. Psittacidae (Parrots)	24
Part B: Migratory Birds	25
I. Charadriidae (Turnstones and Plovers)	26
II. Scolopacidae (Tattlers, Curlews, Godwits)	28
III. Cuculidae (Cuckoos)	33
IV. Anatidae (Ducks)	33
Appendix A: Protected birds	35
Appendix B: Some common trees associated with birds	35
Bibliography	36

Birds of the Gilbert and Ellice Islands Colony

by

Peter Child, B.Sc., Dip. Ed. (N.Z.)

INTRODUCTION

The following notes and observations by an amateur bird-watcher are the result of additions and amendments to a booklet which I wrote while Education Officer at Tarawa, Gilbert Islands, and originally published in January, 1956, as a guide for native schoolteachers of the colony.

I had lived from August 1943 to December 1944 in the Ellice Islands as a radio operator in the Coastwatching Organisation during the Second World War. No systematic notes on the birds were made during this period although many details were later recollected, especially when these islands were again revisited during the second tour of duty for the three years February 1953 to February 1956. This recent post was a travelling one and I was fortunate in being able to visit nearly all the islands in the Colony with the exception of the Northern Line Islands and the uninhabited islands of the Phoenix group. (For information concerning these exceptions acknowledgement is made to the authors of relevant publications quoted in the bibliography accompanying this paper, and to acquaintances who had visited these places and supplied me with verbal reports.) The nature of my work generally necessitated living on each island for periods of several days and thus allowed opportunity for studying the bird-life and visiting (usually by canoe) many remote islets and breeding places which were not inhabited by the native people and which the casual visitor never reaches. These are, of course, the real undisturbed bird sanctuaries of the Colony, where the avifauna is at its best and least afraid of man.

It should be mentioned that no comprehensive survey of the whole Colony has been carried out by a competent ornithologist, and thus there is a noticeable gap in the available literature of the Pacific birds. For the same reason the subspecific names of birds in the western parts of the Colony (i.e. the Gilbert and Ellice groups and Ocean Island) are somewhat in doubt, but the most likely one I have obtained is given in the following notes.

The scientific nomenclature follows that given in Peters' "Checklist of the Birds of the World."

Geography: The Colony comprises 37 coral atolls and islands spanning the central Pacific Ocean. While the land area is very small, approximately 369 square miles, the distances between islands and groups of islands are vast. From Ocean Island in the west at longitude $169^{\circ} 35'$ E. it is some 2200 miles to Christmas Island at longitude $157^{\circ} 28'$ W. in the east; and from Washington in the north at latitude $4^{\circ} 7'$ N. it is some 1000 miles to Niulakita at latitude $10^{\circ} 45'$ S. in the south. Such a rectangle of

* 41 Brandon St., Alexandra, Central Otago, New Zealand.

sea, though not exclusive to the Colony, covers an area of more than two million square miles.

These islands form four groups: there are 16 Gilbert Islands, 9 Ellice Islands, 8 Phoenix Islands and 3 Line Islands; with Ocean Island as an outlier from the Gilbert Islands. The 8 Phoenix Islands include the British-American Condominium of Canton and Enderbury (1939); also, three of the British islands of the Phoenix group, Birnie, McKean, and Phoenix, are uninhabited. The Gilbert and Ellice Islands form a chain lying in a N.W. - S.E. direction astride the equator between longitudes 172° E. and 180° E. The Phoenix Islands are scattered south of the equator between longitudes 171° W. and 175° W. and the three Line Islands, Washington, Fanning and Christmas, lie in a N.W. - S.E. line north of the equator between 157° W. and 160° W.

Geologically Ocean Island stands apart, being an island of the elevated type, its highest point being 280 feet above sea-level. This island is approximately 1500 acres in extent and contains rich deposits of almost pure phosphate of lime on top of the coral base. All the other islands belong to the Central Pacific "area of subsidence," having been formed by the upgrowth of coral around the flanks of mountains long since submerged. Most are atolls, with a ring of reefs and islets enclosing lagoons, the land surface rarely rising more than 15 feet above sea level. A few of the islands are not typical atolls but consist of solid masses of limestone surrounded by fringing reef, one or two having small land-locked lagoons. One (Washington), has a land-locked lagoon which has become a freshwater lake with peat bogs surrounding it.

Bird-life in general: To one who has spent nearly all his life in inland New Zealand, the experience of living so close to the sea (in fact, with the sea) on tropical atolls and observing the very different kinds of birds from those one has been accustomed to, has been a source of great enjoyment and surprise. Prominent among the novelties were

- (1) the absence of "singing" birds;
- (2) the uncommonness of true land birds, by far the majority being oceanic birds and migratory shore birds;
- (3) the large number of migratory species which make these atolls their winter quarters, or a 'halfway house' on their long flights north and south;
- (4) the noisiness of some species during the night;
- (5) the absence of any very small birds (except the Christmas Island "canary" which I have not seen).

Perhaps the food-gathering of sea-birds, demanding as it does much time and prolonged journeys on the wing, is the factor which determines their sizes and wing-spans. In any case, it makes observations and identifications easier for the bird-watcher, and the uncomplicated backgrounds of sea and sand make the task beautifully simple in comparison with the inland and forest habitats of New Zealand.

It seems almost certain that there has been a general decrease in the resident bird population of the Colony over the past two or three human generations, particularly among the more timid and ground-nesting species. Old men who can remember back before the turn of the century have often told me of birds which used to nest on their islands but which

are now rarely, if ever, seen. There also exist some Gilbertese bird-names which the present generation are unable to associate with any particular species now known to them. There appear to be four reasons for this trend: (1), a rapidly increasing human population since the cessation of activities of the "black-birders" about 1880, with subsequent expansion to previously uninhabited islets, increase in killing for food, and general disturbance of colonies; (the black-birders were slave traders who took natives to work in plantations in Mexico and guano mines in Peru.); (2), considerable shooting for food and feathers by the early traders, which may have wiped out small breeding colonies; (3), the increasing numbers of dogs, cats, and rats (the last-names especially since the Second World War), with consequent destruction of eggs and young; and (4), the disturbance caused by military occupation and the construction of airstrips on some islands during 1942-46. Ground-nesting species also suffer from the predations of crabs, especially hermit crabs.

The Gilbertese as a race have apparently never been great bird-eaters, whilst the Ellice people have (and still are). In spite of legal protection, it is not an uncommon sight to see a party of Ellice youth who have been working in the bush return with a "bag" of plucked noddies for roasting over a coconut-husk fire. (In the Gilberts it is mainly in the southern 'drought' islands where any birds are eaten.) Other birds occasionally eaten are frigates and boobies (caught while asleep on coconut palms), pigeons (trapped in special snares or taken as nestlings), and curlews and herons (which are sometimes shot). The eggs of the Grey-backed Tern which breeds in thousands in the Phoenix group, and the Sooty Tern on Christmas Island, are eaten in times of food shortage.

Seabirds have always been reliable guides to interisland voyagers and fishermen, particularly in this Colony where the low-lying atolls are invisible from a few miles out, and where fish form a large proportion of the native diet. The activities of noddies, terns, and others often betray the presence of good shoals of bonito, trevally, and other useful food fish; their regular excursions from islets to fishing-grounds, especially in the early morning and evening, provide a valuable guide for canoe-captains as to the whereabouts of land. Probably much of the old Gilbertese navigation was based upon the regular flying-routes of seabirds. In the Ellice the "tautai" (fishing-captains) have many omens and beliefs associated with the calls, movements and other mannerisms of sea and shore birds.

The scattered islands of the Colony are situated on or near the equator and, although there are occasional stormy westerly periods from November to February, the daily weather and temperatures remain remarkably constant, with prevailing winds from easterly quarters, throughout the year. Because of this great uniformity of seasons the nesting periods of birds are often prolonged affairs, and there is nothing like the same urgency and definiteness one is accustomed to in temperate lands. The Brown Noddy, for example, has been observed nesting at every month of the year! It has also been established that the Sooty Tern, and possibly the Grey-backed Tern, have breeding intervals of less than twelve months.

The commonest and most widely distributed species is probably the Black Noddy, while one of the rarest is the Brown-winged Tern. It is most likely that other species, especially migratory waders, will be reported

from the Colony from time to time. The names are shown as follows:

<u>Scientific Name</u> (Peter's Checklist)	English Name
<u>Ellice Name</u>	Gilbertese Name

Some alternatives are given in brackets.

PART A: RESIDENT BIRDS

I. STERNIDAE (TERNS AND NODDIES)

TERNS or "sea swallows" are the most conspicuous group of birds of this region. The tern family consists of birds of smallish body size having long narrow and pointed wings and long forked tails. The legs are very short and feet small and webbed. The bills are straight, tapered and quite long. When in flight over lagoons or the ocean searching for food the bill is characteristically pointed downwards more or less at right angles to the line of the body. They dive with folded wings from a considerable height into the water and quickly emerge again with their prey, which consists of small live fish, crustaceans, cuttlefish and other small creatures from near the surface of the sea. They prefer live food, and are not scavengers like gulls.

Terns are sociable birds, living and breeding together in huge colonies or "terneries", the noise of which is sometimes deafening, even throughout the night. Males and females are alike in all species. All except the White Tern lay their eggs in hollows on sandy or shingly beaches. Most tropical terns lay only one egg but the black-naped Tern, and very occasionally the Grey-backed Tern, often lays two. Even among terns of one species eggs vary considerably in size, shape and colouring, and hardly any two specimens are exactly alike. The eggs and chicks are usually protectively coloured and difficult to spot among the stones and sand.

1. Sterna sumatrana sumatrana. Black-naped Tern.

Akiaki.

Kiakia.

This small tern is easily distinguished by the black band around the head above the eyes and extending down the nape. Except for the mantle and upper wings, which are a very pale grey, most of the bird is white. The primary wing feathers often have dark grey or blackish tips; the bill and feet are black, and the webs also black. The crown is white. Young birds in immature plumage have somewhat darker mottled colouring.

This bird is common to most western lagoon islands, especially where there are small uninhabited islets of sandbanks such as bikeman (Tarawa), Abanekeneke (Onotoa), Pukasavilivili (Funafuti), and Teafuave (Nukufetau), which are the favourite breeding places. It does not appear to be present in the Line Islands and is relatively uncommon in the Phoenix.

Nesting extends from January to September. The nest is just a shallow depression in the sand or among small coral shingle or among high tide

debris, sometimes sheltered by a tuft of grass or a low saltbush or other shrub. Two eggs are frequently laid. They are smaller than the White Tern's and are pale greenish-blue in background colour with pale mauve spots and blotches all over, and dark brown blotches and markings superimposed. On shingly beaches the eggs are very difficult to see. The average size of 11 eggs measured was 37 x 26 mm.

Sterna fuscata oahuensis.

Sooty Tern.
(Wideawake Tern)

Talaliki.

Keeu.
(Kereekere)

The Sooty Tern is a rare bird in the Gilbert and Ellice groups, there being small colonies only at Teafualiku (Funafuti), Numatong (Nonouti), and Oneke (Kuria). They are very common in the Phoenix and Line Islands, where they sometimes nest among their cousins the Grey-backed Terns. The adult bird has a broad white band on the forehead extending above the eyes; the crown, nape and upperparts are dull sooty black, while the underparts are white, with some greyish feathers under the tail, the bill and feet are black.

According to observations made by Dr. J.P. Chapin, an American ornithologist, and verbal reports to me by the British District Officers who have been stationed on Christmas Island, the Sooty Tern has a breeding interval of only six months there, nesting taking place regularly every June and December.

King quotes a Gilbertese living there as stating the nesting seasons to be December-March and June-August. I have not been able to determine whether a similar cycle occurs in the Gilbert and Ellice colonies; nesting was in full swing with fresh eggs at Nonouti in May, the colony being about 120 birds. One older egg, two flying young and three adults were seen at Funafuti in September, and according to locals the nesting was nearing its end there at that time, the normal population being in "hundreds"; between nesting periods the birds migrate elsewhere - the locals say to the Phoenix group.

A large single egg is laid in a shallow hollow in the sand; it is pale bluish or buff in ground colour, with purplish brown spots and blotches. The eggs vary considerably in size, shape and colourings. The average of 13 eggs measured at the Nonouti colony was 49 x 34 mm. Fishermen, ships' crews and islanders often collect the eggs for food where they are common.

The high-pitched screech of the Sooty Tern is imitated in the common Gilbertese name of "keeu".

3. Sterna anaethetus anaethetus. Brown-winged Tern.

?

?

I have not found anyone in the Colony able to name this bird from a description. Blackman states that it breeds in the 'Phoenix and Ellice Islands'. They were recorded at McKean Island, Phoenix group, by Graffe in 1863 (Finsch and Hartlaub 1867). Sharpe and Whitmee (1878) listed it without giving any details in a collection from the Ellice Islands. Buddle observed several pairs among a large colony of Grey-backed Terns at Canton in June, 1937, but no sign of nesting was discovered.

3 birds seen by the writer at Teafualiku islet, Funafuti (Ellice Is.), seemed to be of this species; they were flying but appeared to be an adult pair and an immature. The natives said these birds nest there but could not be distinguished from the more common Sooty Tern, and there was no separate vernacular name for them. (The adult is similar to the Sooty Tern but is smaller and slightly lighter in colour, and has a narrower white band on the head which extends back beyond the eye. The bill is black, the legs and feet dark grey or black with brownish webs.) The nesting habits were said to be similar to those of the Sooty Tern. During the same month (September, 1955) a young bird brought from Funafuti was examined at Nukufetau, and answered the description given by Alexander for the Brown-winged Tern, and its measurements indicated a smaller bird than the Sooty Tern. (Bill: 1.4; tarsus: 0.9; length: 14.0; wingspan: 28 inches.) However as the colouring of the two species is almost identical, and as it was only the immature which was handled, the identification remains in some doubt. It seems possible that a small colony of this species mingles with the Sooty Terns during the breeding season at Funafuti.

4. Sterna lunata.

Grey-backed Tern.
(Bridled Tern; Spectacled Tern)

Talaalofi.

Tarangongo.
(Maningongo)

These birds are no longer breeding in the Gilbert and Ellice groups, although it seems that they did so on a few islands in days gone by. They still breed in immense colonies in the Phoenix Islands. There is a very large colony on the southeastern end of Canton.

The adult is similar in build to the Sooty Tern but slightly smaller, and the upperparts are soft grey instead of sooty black; the underparts are white and the feet and bill black. The head is black except for a white forehead and a white band extending back above each eye.

The birds nest on the ground, laying their eggs in hollows among stones and creepers; sometimes the hollow is lined with small bits of coral and rock (Bailey once recorded two nests with two eggs in each, at Canton.) Undoubtedly May-June is the height of the nesting season as recorded by observers on Canton, but, according to one boy informant of mine, a native from Hull Island, the species has two nesting seasons per year, the second being in December.

The eggs of this species are sometimes eaten at Manra (Sydney) and Orona (Hull), especially during times of drought when food is scarce.

5. Thalasseus bergii. Crested Tern.
(Swift Tern)
- Tala Karakara.
(Talaalofi) (Kabiniwa)

The eastern subspecies is T. b. cristatus while that in the west is more likely to be T. b. pelecanoioides, according to Baker.

With a wingspan of about 40 inches, this is easily the largest tern in the Colony. It is unknown at Nui, Niutao and Vaitupu, but otherwise appears to be present in small numbers on most islands.

The crown and nape are black with elongated feathers from the nape forming a crest from which the bird is named. The upperparts are light and dark greys while the neck and underparts are white. The feet are blackish with dark webs. A conspicuous feature which helps identify this bird is the large yellow bill. It dives for fish from a considerable height, and is often seen hovering over the lagoon shallows uttering the harsh cries from which the Gilbertese name 'karakara' is obtained. The other name, 'kabiniwa' means 'canoe-hull' and probably refers to the shapely body of this fine bird.

Crested Terns are said to nest in small colonies on sand or gravel bars similar to those occupied by the Black-naped Terns. However, no one was ever able to show me an actual nest or egg, and in none of the literature is there a report of finding them. It is said that one egg is laid between December and February. I saw several immatures in July at Onotoa, and Moul records one from there on August 19. In May an immature bird was being fed small fish by a parent on the lagoon reef at Betio, Tarawa.

NODDIES belong to the same family as terns, and in appearance and habits they are similar to terns; the two most widely distributed noddies found in the Colony are, however, much darker in colour than any of the terns and so are easily distinguished from them. The fork of the tail is not so deep on noddies as on terns, and in flight noddies often have the tail closed so that the fork is not noticeable at all.

Their food is similar to that of terns but, unlike terns, they do not dive below water for it from a height but skim around fairly close to the surface and plunge in briefly when the prey is sighted. Although their feet are webbed noddies spend very little time on the surface of the water as their feathers soon become waterlogged; occasionally flocks of birds are seen during fishing operations resting on the ocean or lagoon.

6. Anous stolidus pileatus.

Brown Noddy.
(Common Noddy)

Ngongo.
(Uii)

Io.

This is the largest of the noddies and is readily identified by its dark brown colour. The crown and nape are pale grey, almost white on the forehead, and there is a black band from the bill to the eye. There is a prominent white semicircle under each eye. The rest of the body is dark brown with lighter brown shades on the underparts. The bill is black and the feet brownish-black with yellowish webs.

They are fairly common on all islands of the Colony. In some places, such as Canton and Christmas Island, they have been known to nest on the ground among coral blocks, but the favourite nesting place is the butt of a coconut frond, in the axil between the butt and the main trunk; this site distinguishes them from the Black Noddy which nests further out on the petiole where the small leaflets begin. At Onotoa two nests were found in the whorls of leaves of the pandanus.

A rough nest is made of twigs, dead leaves, roots, and coconut fibre. One large egg is laid, pale buff in ground colour with large purplish-brown spots and blotches, more dense towards the wider end. Average size of eggs measured at Nonouti was 52 x 34 mm. Nesting seems to be most common between March and September, but eggs may be found in different localities during any month of the year.

The adults utter a very harsh cry, "krrrrr", from the tree-tops, especially when their nests are disturbed. They are sometimes nicknamed 'the angry birds' by the natives because of this habit.

7. Anous minutus minutus.

Black Noddy.
(White-capped Noddy)

Taketake.
(Lakia)

Mangkiri.
(Kunei; Takiri)

This is a smaller dark-coloured noddy, and probably the commonest bird in the Colony, being listed in large numbers on all islands visited by the writer. Its general colour is very black with a noticeable contrasting white crown and forehead and a white semicircle under the eye. The bill is black and the feet dark brown, almost black.

The birds congregate in large colonies, especially during nesting time, and their continual chatter can be heard from afar. As mentioned above, one of their favourite nesting places is on palm fronds where the small leaflets begin to grow out from the rib, and on some trees one may find a nest on almost every near-horizontal frond. On some islands Tournefortia and Pisonia are the favourite nesting trees, while on others with dense colonies where trees are limited nests may be found on the ground. Several nests may occur on one branch, and even on coconut palms two and three on one frond are not uncommon. The nests are roughly

constructed of small twigs and roots, dead leaves, old feathers and other scraps of rubbish, stuck together with droppings, the whole forming an untidy and smelly mess. In dense colonies the ammoniacal smell of excreta is almost overpowering, there being a thick coating of decaying leaves and droppings over the ground and lower branches. Only one egg is laid, creamish or buff or bluish-olive in ground colour, with purplish-brown blotches and spots, more dense near the wider end. The eggs vary in size, shape and colourings but are always smaller than those of the Brown Noddy. Average of 15 eggs measured was 43 x 30 mm.

The season lasts mainly from February to October, with the greatest activity perhaps in June, but some eggs may be found in different places all the year round. There are very large breeding colonies of thousands of birds on Numatong (Nonouti), Tabuarorae (Onotoa), Namauri (Tabiteuea) and Nikumaroro (Gardner Island). Smaller colonies are scattered throughout all the other islands. I once spent a night among the Numatong colony; the smell and commotion prevailed throughout and this, together with the perambulations of ghost crabs, dispelled all ideas of a night's rest. Noddies seem to be ever restless, except during the heat of the day which seems to be their quietest period, when they sit among the treetops calling and preening; probably, however, most of the birds are out at sea fishing at this time and, on returning in the evening, the hubbub resumes. Probably because their feathers are less waterproof than those of most seabirds noddies shake themselves in the air after diving or periodically during heavy rain. During extremely heavy rain I have seen them descend and rest on the water.

8. Procelsterna cerulea nebouxi Blue-grey Noddy.
(Bennett's Noddy; Blue-grey
Fairy Ternlet.)

Talaliki.

?

This is the smallest of the tern family in the Colony, being only 10 to 11 inches in length. It is entirely light bluish-grey except for paler silvery-grey or whitish underwings; the bill is black and the feet black with yellowish webs.

Now a rare bird in the Gilbert and Ellice groups, a specimen was collected by Whitmee from the Ellice Islands in 1876, probably from Funafuti. They have been observed on several islands of the Phoenix group: McKean (Gräffe in 1863, listed in Finsch and Hartlaub, 1867); Phoenix, Sydney, Birnie, Canton (Lister in 1889). They are common at Fanning (Kirby in 1924), and Christmas Island (King in 1953). The subspecies at Christmas Island is listed as P.c.cerulea by King and also by Alexander.

The nesting period appears to be about July to January. One egg is laid in a hollow among coral or on bare sand, the nest being lined with a few sticks or coral fragments. The egg is pale cream with rich brown spots and underlying pale greyish-brown spots.

9. Gygis alba.

White Tern.

(Love Tern; Fairy Tern;
Angel Tern)

Matapula.

Matawa.

(Matawanaba; Bairuti)

Baker (p. 179) states that the systematic position is in doubt. In the eastern region it is probably G.a.candida as listed by Bailey and others, and by my measurements from live birds caught at Tarawa the subspecies in the west is probably G.a.pacifica, which is a slightly larger bird.

The beautiful little White Tern is fairly common on all islands except Arorae, where surprisingly it is not present at all; pairs of birds will usually be seen hovering near pandanus trees or playing on the branches. They are easily distinguished by their pure white colour and arboreal habits. The shafts of the primaries are dusky brown and of the tail feathers almost black. Mayr describes the bill and feet as black; however all specimens examined by me in this Colony have a bill which is deep navy blue at the tip to a paler blue or royal blue at the base, while the legs and feet are light blue or greyish-blue with white, yellowish or flesh-coloured webs. The prominent dark eyes have a narrow black ring around them.

These birds are not easily frightened and show much curiosity by fluttering close over one's head and uttering shrill nervous calls, especially when one approaches a nesting-site. No nest is built and only one egg is laid; favourite places are the tops of old coconut stumps, forks of pandanus and tree-heliotrope, or simply the rough bark of a horizontal branch of these trees, and sometimes nothing more secure than the top (slightly concave) surface of bare palm frond petioles; needless to say these are precarious places for eggs, yet few are ever seen dislodged. At Ocean Island eggs may be found in hollows and ledges on the large coral blocks and pinnacles which remain after phosphate mining, or occur naturally around the coast.

The eggs are pale bluish-green marked with brownish and purplish blotches and scrawly lines; average size for five eggs measured was 38 x 30 mm. I have seen eggs every month of the year, but the main nesting season is probably about May to January. The young cling to the branch with their small sharp claws and are not easily dislodged. An adult may often be observed arriving at the youngster with a bill full of tiny silvery fish from the lagoon or ocean; it is remarkable how it manages to catch the last few with its bill already half full, for up to a dozen have been seen in a bill at one time. These are fed to the fledgling one at a time directly from the bill. The rather dusty grey down of the chick compares unfavourably with the brilliant snowy whiteness of the parents, but is of considerable value as camouflage on the branch. During feeding operations over the lagoon young flying immatures are often harassed by the noddies who give chase until the tern drops a fish, which is then smartly retrieved by the noddy before it reaches the water.

(Terns and Noddies
(A simple identification chart)

<u>Plumage:</u>	<u>Size</u>		
	<u>Large</u>	<u>Medium</u>	<u>Small</u>
Mainly dark, light crowns.	_____	Brown Noddy	Black Noddy
Dark upperparts, white underparts.	_____	Sooty Tern	Brown-winged Tern
Greyish upperparts, white underparts.	Crested Tern	Grey-backed T.	Black-naped Tern
Nearly all pale grey	_____	_____	Blue-grey Noddy
All white	_____	_____	White Tern

II. SULIDAE (GANNETS OR BOOBIES)

Three members of this family occur in the Colony although only one of them, the Brown Booby, is commonly known in the Gilbert and Ellice Groups, the other two being but occasional visitors.

The birds are similar to the species in New Zealand, large and heavily built, with stout thick necks and very stout powerful beaks, short legs with large webs between all four toes. There is an area of naked skin on the face and throat, the colour of which helps identify the species. The flight is steady and deliberate, usually fairly close to the surface of the water.

The name booby (from the Spanish "bobo" - a fool) appears to have arisen from their apparent stupidity in allowing people to approach them so easily, and because they permit themselves to be continually robbed of food by the frigate-birds. A frigate will sometimes grab the booby by the tail in flight to make it disgorge some fish which the frigate then usually manages to retrieve before it hits the water.

10. Sula leucogaster plotus.

Brown Booby.
(Common Booby)

Kanapu.
(Kanopatua)

Kibui.
(Tairo ?)

Single birds or small groups are often seen flying around lagoons or resting on beacons or buoys. The adult is dark chocolate-brown on the upper-parts and breast, white on the abdomen, underwing and under-tail coverts. The bill is pale bluish or yellowish, with greenish-yellow on the skin of the face. The legs, feet and webs are also greenish-yellow.

The Brown Booby eats a variety of herring-like fish, or fish that are similar in habits to the herring. To get its food it dives from a considerable height and often pursues its prey under the water; it has been caught in fishermen's nets at a depth of as much as 90 feet.

It is a ground-nesting bird and builds a rough structure of twigs and seaweed. Two eggs are usually laid but only one chick is raised. The eggs are large and pale blue, covered with a white chalky layer which can be scratched off. The young bird is fed on partly digested fish by thrusting its bill and head into the throat of the parent. The nesting season is about March to August. No breeding places are known in the Gilbert and Ellice groups. Fanning, Christmas Island, Canton and other Phoenix Islands are known to have nesting colonies.

About thirty birds were roosting on the tops of coconut palms at Numatong (Nonouti) in June but there was no evidence that they nest there. One of my native companions climbed a palm at night and caught one of

these, which we measured. While roosting or breeding these birds, which are usually silent, utter loud quacks and honking noises. Mr. G. B. Gallagher, a British District Officer who died at Gardner Island in 1941, had a tame booby he called "Honk".

11. Sula dactylatra personata. Blue-Faced Booby.
(Masked Gannet)
- Kena. Mouakena.
(Loka)

The Blue-faced Booby is seldom seen in the Gilbert and Ellice groups; an occasional one is picked up by parties out bonito-fishing in the ocean; Kennedy saw only one in five years at Vaitupu. They are fairly common on Christmas Island, rare on Fanning and Washington, and present in small numbers on Canton, McKean, Gardner, Phoenix and Sydney of the Phoenix group.

The adult is a large white bird with contrasting dark brown primaries and tail feathers. The bill has a horn-coloured tip, the base being orange-yellow in males and pinkish in females; the feet are olive-drab in males and lead-grey in females. There is a conspicuous patch of dark blue skin on the face and throat. Although the colouring is similar to that of some individuals of the Red-footed species it may be distinguished from the latter by the fact that the feet are never red; also a smaller area of the wings is brown, and it never nests in trees.

The Blue-faced Booby nests on the ground, a shallow depression in the sand, without other materials, forming the nest; two eggs are laid but only one chick is raised. The nesting season lasts from about April to December in different localities.

Its feeding habits are different from those of other boobies, for it lives almost entirely on flying-fish, which it seizes at the surface of the water or even in the air.

12. Sula sula (rubripes?): Red-footed Booby.
- Tapuku. Keta.
(Talanga?) (Makitaba)

The Red-footed Booby differs from the other two species in its nesting and feeding habits. It lives mainly on squid which it catches in the twilight of early morning and evening when squids and other creatures from the ocean depths come to the surface.

It is one of the few tree-nesting boobies of the world, and builds a rough nest of dry twigs; at Canton these are mainly on Scaevola bushes; at Christmas Island on Tournefortia, and at Gardner on Pisonia. Large nesting colonies have been reported at Fanning and Washington, and smaller colonies on most of the Phoenix Islands. There is a possible nesting site at Bakatorotoro (Abaiang) in the Gilberts. A young nestling in white down shown to me at Tabuarorae (Onotoa) in August, 1955, was found on the broken

trunk of a Pisonia, and appeared to be of this species. No other nests were found and it was probably an isolated case. These birds are also said to roost but not nest on Pisonia trees on the islets of Tenon and Namauri at Tabiteuea. There was no sign of them there in January, 1956.

Only one egg is laid and the young birds, like those of other boobies, are covered with a coat of thick white down for several months. The nesting season is from April to December in different localities; the eggs are similar in appearance to those of the Brown Booby.

Measurements, colourings and classification are discussed at some length by Murphy et al. in the booklet "Canton Island"; it appears that the birds in this region are smaller than those elsewhere, possibly warranting a new subspecific name to distinguish them from S. s. rubripes. Further measurements are needed on birds from these islands other than Canton.

III. FREGATIDAE (FRIGATE-BIRDS).

These pirates of the Pacific skies are well-known throughout the Colony; nearly every island has a few birds soaring over the land or surrounding ocean during the day, and resting on the palm-tops or other tall trees at night. When one comes to find where they nest, however, it is a different story, and many wild rumours are told. I was not able to find for certain a single nesting-site in the Gilbert and Ellice groups; also no males with the characteristic red inflated gular pouches were observed in that region, although I was told that occasionally one such is seen. There are, however, plenty of birds of various ages - all flying of course. Immature males are common.

Frigates are the largest birds seen in the Colony, fully grown ones having wing-spans of six to seven feet. Of the five species in the world, two occur here, and their identification is difficult except in mature adults. They inhabit windy situations for if grounded in a sheltered position they are helpless and unable to rise into the air. During violent westerly storms in the Ellice Islands an occasional frigate would reach us on the beach on the sheltered lagoon side and was unable to do anything more elegant than flap clumsily along the beach with its wingtips hitting the sand. Also for this reason, nesting and roosting sites are in exposed places, and tame birds are usually kept on elevated perches on the windward side of the atolls.

The long forked tails of these birds are sometimes not apparent when in flight. If angered or disturbed the birds snap their tails in a scissor-like fashion. The legs are very short and, although the feet are partly webbed, they seldom rest on the water. Personally I have never seen one do so but then I have not lived for any length of time among a large colony. According to the report by Degener and Gillaspy one of them saw "a small flock of frigates playfully land, float and rise again from the placid waters of the lagoon". From my own experiences, the word 'placid' used here is puzzling - surely the incessant trade wind of Canton was necessary for the birds to take off. The bill is long and slender with a sharp hook at the tip; when annoyed the birds have a curious habit of rattling the

bill. On the throat there is a patch of skin which, in mature males, can be inflated with air to form a large red balloon (gular pouch) in the breeding season.

Their food consists of flying-fish, other small fish, jellyfish, molluscs and other creatures picked up from the surface with a swift movement of the bill when they are in flight; more often, however, they pursue noddies, boobies and terns and force them to give up some of the food they have swallowed, which is then usually caught by the frigate-bird before it reaches the water. It is this habit which has earned them the nickname of 'man-o'-war hawk'. When other species are returning home in the evening the frigates descend from their lofty soarings and pester the smaller birds until a meal is consumed. In the Gilbert and Ellice groups the noddies are the commonest victims, while at Canton and some other islands boobies are the ones most attacked.

Their nests are clumsy structures of twigs, placed on low bushes or trees, or sometimes on the ground in windy situations. Although a single large egg is usual, Lister observed a few nests containing two on Phoenix Island. Both parents share the incubation; if the nest is neglected other frigates will rob the sticks, or egg, or kill the youngster. Immatures can always be distinguished by their white or rusty-coloured heads, and it is probably at least two years before adult plumage is attained. Females are larger than males.

In some Pacific territories frigates have been used as message-carriers from one island to another, and there is one genuine story of a strange frigate which was caught by an Arorae man who attached a note to its wing and released it; the bird returned to its owner who was at Ocean Island, about 450 miles away; the Arorae man later received a letter of thanks for returning the bird. Since there appear to be no breeding colonies in the Gilbert and Ellice groups the frigates seen there must all cover at least several hundred miles in their flights from the Phoenix colonies.

The long primary feathers are used in the Gilbertese game of "Kabane", in which a model 'bird' is catapulted vertically into the air while, from twenty yards or so away, the 'hunter' attempts to bring down the bird with a slingstone weighing 7 oz. attached to 25-30 fathoms of line. Now used only as a game, the pastime was formerly a practice for the actual attempts on the soaring birds. Also in the old days canoe crests of certain clans were made of the primary feathers of frigates. In order to tame the birds some natives use special diets, such as a particular species of small fish, or boiled abdomens of hermit crabs. Others, when feeding the bird, add some of their personal hair-oil to the food and rub some oil on its bill; in this way they claim the bird can recognise its own master.

13. Fregata minor palmerstoni.

Greater Frigate-Bird
(Pacific Frigate-Bird)

Katafa.
(Manulasi)

Eitei.

Males are called Marenaiti or Bairakau; or, when the red gular pouch is showing, Koko or Tarakura (Ellice: Talakula or Katokula); females are

called Ubamara or Ubaimoa, and young birds Ubaitoi or Ubamei (Ellice: Upaitoi).

The adult male is dark brown to black all over, with a bluish-grey bill and black, brown or pink feet. It is the darkest bird of either species and is thus easily identified. The female has a dark brown or blackish head, neck, upperparts and abdomen, but the throat and breast are white. Immatures have white or rusty coloured heads and patches of white on the breast and abdomen; by the shape of these patches it is usually possible to tell whether the bird is male or female.

Canton and other Phoenix Islands, and the Line Islands, are known breeding places. The nesting season is an extended one and lasts at least from March to September. A large flock of an estimated 200 birds rested on Pisonia trees at Tabuarorae (Onotoa) but there was no sign of nesting there; these were observed coming in to roost in the evening twilight only, and could have been of the species F. ariel.

14. Fregata ariel ariel.

Lesser Frigate-Bird.

Katafa.

Eitei.

Not many islanders can distinguish this bird from its near relative described above, and it is difficult to identify females and young birds, which are similar in markings to those of F. minor. However the male is easy to distinguish from below as it has a white ventral side patch under each wing, the remainder being dark brown to black. The white on the breast of the female extends back under each wing corresponding roughly to the side patches of the male; this is about the only easy way of distinguishing it from a distance from F. minor female. All are smaller birds than F. minor.

It is not so common as the Greater, but I have seen a few at Nonouti, Funafuti and Nukufetau, and possibly the flock mentioned above at Onotoa. Moul reported them from Onotoa. The only nesting place reported in the Colony is the large one observed by Lister in 1889 on Phoenix Island.* Thousands of nests on the ground with eggs but no young were observed in June. Although they have been seen at Canton Buddle concluded that they do not breed there.

IV. PHAETHONTIDAE (TROPIC-BIRDS OR BO'SUN BIRDS)

This family is represented by only three species in the world, of which two occur in this Colony. With their delicate plumage colouring and unusual median tail-streamers, they are among the most beautiful of sea-birds. The plumage is mainly white, with a roseate tinge ventrally, and a few black markings; the black bar through the eye is a prominent feature. They have long wings, thick straight bills, and short legs with all four toes webbed. They are diving birds, feeding chiefly upon fish and squids.

* Bird listed as F. minor but Lister's detailed description (1891) fits F. ariel.-Ed.

A single bird or a pair is often encountered at sea, when they will circle around the ship for lengthy periods, occasionally uttering a shrill rasping cry. The flight is somewhat undulating with the wings beating constantly and steadily something after the manner of pigeons. I have not seen them settle on the water although it is said they occasionally do so.

15. Phaethon rubricauda melanorhynchos. Red-tailed Tropic-bird.

Tavaketoto.

Taake.

There now seem to be no definite nesting places for these birds in the Gilbert and Ellice groups; there was once a considerable colony at Nui on an islet called Bikentaake (= "Island of the Tropic-bird"), but the birds have not returned there for many years. The chief breeding places are now in the Phoenix and Line Islands; known colonies occur on Gardner, Hull, Phoenix, McKean, Sydney, Canton and Christmas, and rarely on Fanning. Nests are situated on the ground under saltbushes (Scaevola) or other small shrubs, or between rocks or under overhanging rocks; a few dead leaves are all that go to make the nest. Only one egg is laid, it being reddish-brown in ground colour and beautifully marked with larger blotches and streaks of purplish-black. Nesting lasts from May to November. Both young and adult birds protest loudly if the nest is approached, and will often strike with their stout bills.

The newly hatched young are thickly covered with white down; later some black markings and bars appear on the back and wings; in adults these have disappeared except for a small patch on the wings and flanks, so that the plumage is chiefly white, often tinged with rosy pink or salmon shades. There is a characteristic black streak curling through each eye, and the shafts of the primary and tail feathers are black. There are 14 white tail feathers and the two median red streamers from which the bird is named. The bill is usually an orange or vermilion shade, with a black streak through the nostrils; the legs and bases of the toes are pale blue, and the rest of the feet black.

The red tail feathers are obtained merely by pulling them out; they were much sought after in the last century by milliners, and in earlier times were worn in some islands of Polynesia as a sign of chieftainship. Of three red tail-streamers which I was given from Christmas Island the longest measures 18.2 inches. For some of the village prophets in the Gilberts the appearance of this bird signified good luck, but for others approaching death in the clan; it is thus apparent that the species has never been common there.

16. Phaethon lepturus dorotheae. White-tailed Tropic-bird.

Tavake.

Ngutu.

(Tavakepuka; Tavakelau)

(Koroangutungutu; Tarangotu)

This bird may easily be distinguished from the Red-tailed species by its two long central tail-streamers, which are pure white and not as narrow as the red ones. The next adjacent feathers are also fairly long.

and there are 8 shorter tail feathers, making 12 in all. There is more black on the wings and flanks, with the rest of the plumage mainly white, with or without the roseate tinge; the black eyestreaks are not so heavy. The bill is yellowish, base greyish; the legs and bases of the toes are yellowish or flesh-colour and the rest of the feet black.

These birds nest high up on Pisonia trees (called 'puka' in the Ellice), or on the clumps of epiphytic ferns which often occur well up on the trunks of coconut palms in the relatively high rainfall belt in the Ellice. On Fanning and Washington the favourite nesting site is said to be the top of a tall coconut stump. (According to Kirby the former owner of Christmas Is., Father Rougier, accounted for its absence there by the lack of crownless coconut trunks.) Other known nesting places are at Vaitupu, Meang (Nui), Lafanga (Nukufetau), and Gardner Island. Two eggs are laid and the nesting season extends from about November to April. The eggs and young are similar to those of the Red-tailed, and immatures of the two species are difficult to distinguish until the long tail feathers develop.

V. PROCELLARIIDAE (SHEARWATERS AND PETRELS)

The shearwaters earned the name from their habit of skimming low over the waves, with one wingtip almost touching the water, in search of food, which consists of fish, squids, crustaceans and other pelagic marine creatures; they often follow the ship in search of scraps of food, either thrown overboard or disturbed by the turbulence of the propellers. In the region of the trade winds they glide effortlessly over the wave-crests with hardly a wingbeat, and one is constantly amazed at their ability to stay airborne. Equally amazing is their sudden appearance and disappearance from the vicinity of the ship; they never approach very close, and their identification at sea is notoriously difficult. They are all rather dull-coloured birds of some scheme of blacks, browns, greys and whites. The bills are strong and sharply hooked at the tip, those of the petrels being relatively shorter and stouter than those of shearwaters. The feet are webbed, and they sometimes settle on the water and swim about while feeding or resting.

Only five members of the family are resident in the Colony, and none of these is well-known in the Gilbert and Ellice groups, being but occasional visitors encountered at sea. Their breeding places are found in the Phoenix and Line Islands, especially at Canton and Christmas Island. They spend nearly all their time at sea, and on land their legs are hardly strong enough to support them, so that they often shuffle along on their breasts with the help of their wings.

17. Puffinus pacificus chlororhynchus. Wedge-tailed Shearwater.

Kumala.

Korobaro.

This is a large dark bird with upperparts dark chocolate-brown, blackish on the primaries and tail. The tail is rather long and wedge-shaped. The underparts undergo colour phases during the year so that

sometimes they are greyish-brown, and sometimes white. The Bill is pinkish with a darker tip, and the feet are yellowish flesh colour or whitish.

Breeding places have been reported at Canton, McKean, and Christmas; the nesting season lasts from May to August. The nests are in burrows beneath soft soil or sand, often five feet or more in length, the nest proper being a mere hollow at the end and sometimes lined with a few bits of grass or feathers. One white egg forms the clutch. There is much flying about and activity over nesting places at night and both male and female parents take turns at incubation. The young are fed on an oily food which is regurgitated by the parent, and they become very fat and often larger than the parents. The parents leave the young before they can fly properly, and this store of fat keeps them alive until they are able to leave the burrow and head off to sea. At night low wails and moans rend the air over the breeding grounds as the sitting parents welcome their mates returning from the ocean.

18. Puffinus nativitatis. Christmas Island Shearwater

?

Tinebu.

The colouring is similar to the dark phase of P. pacificus, but the bird is smaller and has a black bill and feet. The calls are said to be more of a barking or "humphing" nature than the mournful wailing of the Wedge-tailed. Breeding places are known at Christmas Island, Canton and Phoenix Island. Nesting occurs from May to December on the surface of the ground, under bushes or in a crevice among rocks.

19. Puffinus lherminieri dichrous. Dusky Shearwater.
(Audubon's Shearwater)

Tapuku.

Nna.

This is the smallest of the local shearwaters; it is dark sooty brownish-black above, with white underparts. The under tail-coverts are black and the sides of the breast grey. The bill is short and black, with the feet flesh or yellowish.

They nest in burrows excavated in the sand, from about July to September. P. dichrous was described from McKean by Finsch and Hartlaub (1867) from a specimen collected by Gräffe. Alexander records them from Christmas Island but King does not include them in his list from there. Bailey and others observed burrows on Canton in May and June.

20. Pterodroma alba. Phoenix Petrel.

Lulu.

Tangiuoua.
(Ruru; kuma)

Comparable in size or a little smaller than Christmas I. Shearwater (14 inches according to Mayr).

Called the "kuma" at Nui, this bird is more commonly known as the "tangioua", meaning "two cries", because of the two different kinds of sounds which it makes: one is a high-pitched warbling cry and the other a low bubbling or gurgling sound. There is a belief among some Gilbertese that if the cry of this bird is heard above someone's house during the night there will be a death in that family in the near future.

It is probable that the species was more well-known in the Gilbert and Ellice groups many years ago than it is today, and there now appear to be no nesting places in those groups, and not many of the younger people have seen the bird. The nesting season seems to be a prolonged one; eggs have been found at Christmas Island from June to February. Other breeding colonies are at Canton, Phoenix Island, and possibly Gardner. One white egg is laid, usually on the surface of the ground under clumps of vegetation, or occasionally in shallow burrows.

The adults are most active at night, and in the late afternoon and evening. They are sooty black above with a dark band across the upper breast, and dark underwings. The throat, lower breast and abdomen are white; the bill is black, and the feet yellow with the ends of the webs black.

21. Nesofregatta albigularis.

White-throated Storm-petrel.

?

Bwebwe-ni-marawa.

Storm-petrels are the smallest of the seabirds, the above species being only about 8 inches in length. It has long legs and webbed feet, the legs (tarsi) and toes being remarkably flattened laterally, and the legs so long that they extend beyond the tail in flight. Except during the breeding season and when blown ashore by storms, all their time is spent at sea, and on land they are unable to walk and have to use their wings to help them shuffle along on their breasts. At sea they sometimes seem to pat the surface with their feet to assist the skipping movements in search of food, so that they seem to be walking on the water. Occasionally they rest at sea. The food consists of shrimplike creatures and other tiny animals from the surface of the ocean. They often fly in groups across the waves, with a jerky, erratic flight which has led some people to believe they are large butterflies - the Gilbertese name means "butterflies of the ocean".

The adult is sooty-black to greyish-black above with a noticeable white patch across the rump, and a sooty band across the breast; the throat, lower breast and abdomen are white, and the underwings smoky-white; the tail is long and deeply forked, and the bill black.

In the breeding season they make burrows in the soft soil or under bushes or among rocks; a single egg is laid, creamy-white in colour, with small reddish-brown and faint purplish spots, more dense at the wider end. Both male and female take turns at incubation. Breeding colonies are quiet during the day but very noisy at night when the birds from the sea return to relieve their mates. The young bird is fed disgorged oily food from the parent and, like the young of Shearwaters, grows bigger than the parents, who desert it before it can fly.

Eggs have been found in July on Phoenix Island (Lister), and in December on Christmas Island (King). No other breeding places in the Colony have been reported. Two birds seen near the ship between Tarawa and Ocean Island in January, 1956, were certainly of this species, the long legs and white rump-patch being prominent. This suggests a very wide feeding-range if the Phoenix Islands, nearly 1000 miles East, are the nearest nesting places.

VI. ARDEIDAE (HERONS)

22. Demigretta sacra: Reef Heron.

Matuku. Kaai.

The Reef Heron is the only wading bird which is permanently resident in the Colony. Often mistakenly called a crane or stork, it is one of the most conspicuous birds of the beaches and reefs; hunting small fish in the shallows and tide pools, or flying with great slow beats of its broad wings over the lagoon it is a graceful and attractive bird. There are three colour phases: pure white, greyish-blue, and a third chiefly white but mottled in varying degrees with the blue-grey feathers; local names for the three types are:

White Heron:	Matuku kena.	Kaaimatang.
Blue Heron:	Matuku uli.	Kaaibuaraku.
Spotted Heron:	Matuku pulepule.	Kaaimakin.

In each kind the legs and feet are yellowish-green, or dull olive green, and the bill is dull orange, often marked with blackish or purple on the upper mandible. It was more difficult than it at first appeared to count the relative numbers of the three phases along a stretch of ocean reef at low tide, not only because of the movements of the birds, but also because the Blue Herons were so much better camouflaged against the dead reef coral-heads; my estimates were that the ratio of Blues to Whites was about 2:1, with the mottled variety present to the extent of about one in every 10 birds. (These observations were for Tarawa, the ratios on other islands not necessarily being the same.)

The long neck and legs are used to good advantage when wading in the shallow waters on the reef or lagoon in search of food, which consists chiefly of small fish and crustaceans of many varieties, often brightly-coloured; quite often a bird will be seen chasing a lizard (Emoia cyanurum) along the land vegetation, or hunting worms, insects and small fish in the babai pits; another habit is that of drinking the 'toddy' (flower sap from the bound spathe of a coconut palm) from a hanging cup or coconut shell high up on the palms. Usually a single bird or a pair is seen in one territory, but at high tide there may be a gathering of ten or more in some quiet spot among bushes along the shore, or on the low branches of a mangrove thicket.

In the Colony the bird is a familiar sight on all islands of the Gilbert and Ellice groups, but surprisingly is not seen in the Phoenix and

Line Islands. The nesting season lasts from November to June. A rough platform of sticks and dry twigs or rootlets comprises the nest, which is normally situated on high coconut or pandanus trees; one nest at Onotoa was, however, only four feet from the ground, in an 'uri' tree (Guettarda speciosa). Two or three pale greenish-blue eggs form the clutch, and the nestlings are very ugly and awkward for many weeks. Immatures which have just left the nest have weak legs, rather untidy feathers, and are not able to fly more than a few yards at a stretch; their natural ability as fishermen is, however, well developed. The feathers, particularly of the white phase, are often used for decorative purposes in fans and other handicrafts. A guttural call is heard, mainly from nesting adults.

VII. COLUMBIDAE (PIGEONS AND DOVES)

23. Ducula pacifica pacifica. Pacific Pigeon.

Lupe.

Rube.

Although common throughout most of the Pacific, this large pigeon is found in the Colony only in the Ellice group. (A few semi-tame birds have been taken as pets to some islands in the Gilberts.) In the Ellice they are uncommon at Niutao and Funafuti, fairly plentiful at Nui and Vaitupu, and present in small numbers on all the other islands. According to Whitmee this is a smaller bird than the Samoan race; total length is about 15 inches.

The upper wings and back are grey with a greenish sheen and some brownish tints; the head, neck and underparts are light pearly grey, with pinkish tints on the underparts; the under tail-coverts are deep reddish-brown, and the underwings grey. The bill is dark grey to black, and there is a characteristic large soft operculum or cere at the base. The feet are bright coral red.

Berries of various trees are the favourite food, common ones eaten being 'uri' (Guettarda speciosa), 'bero' (Ficus), and 'mao' (Scaevola). They are also known to eat ripe breadfruit from the tree, and, like the herons, will be seen drinking the toddy from a hanging shell. The call is a deep cooing, something like "pr-rrr-ooo-oo".

Nests are usually built high on coconut palms at the bases of the petioles; at Nanumanga in the Ellice they are said to nest on mangrove shrubs. Two oval white eggs are laid, and the season lasts from about June to September.

24. Gallicolumba erythroptera: Ground Dove.

Lupe palangi.

Bitin.
(Taobe)

While Ducula is a native in the Ellice, being referred to in many old songs and legends, the ground doves are undoubtedly recent introductions of the present century, probably mainly from Fiji. At Abemama they are

reported to have been introduced from Nauru about 20 years ago, and have multiplied considerably so that there is now a fair number in a wild state. A few pairs have also been taken from Abemama to some other Gilbert Islands as pets, but in most of the Colony they are unknown. A pair taken to Nonouti had four offspring, and in June two females had nests about ten feet off the ground in an old deserted house; the nests were of grass and straw and built inside old boxes; each contained two eggs, oval in shape and creamy-white in colour. At Abemama they are said to nest in coconut crowns, often high above the ground. They feed mainly on the ground; when disturbed they fly up into the palms and their call, a soft "coo", may then be heard.

The colouring is typically darkish greys and white; the head, neck, back and upper breast are grey with a purplish and greenish sheen or iridescence; the secondary wing feathers are mainly dark grey and the primaries and tail feathers mainly white; the abdomen is white, often speckled with grey, and the under tail-coverts white. The short bill is dark grey with a small whitish operculum at the base; the legs and feet are coral red, or purplish red. Some birds have less white than others, and hardly any two are exactly alike.

25. Gallicolumba stairii.

Friendly Ground Dove.

There are a few individuals in a semi-wild state at Abemama, probably of this species, and probably introduced from Fiji where it is common. The habits are similar to those of G. erythroptera, and there is no distinction in vernacular names of the two species.

The colouring is mainly brown with a little white on the wings and lower breast; the upperparts have a greenish sheen in some lights. The bill is dark and the feet deep red or purplish red.

VIII. PHASIANIDAE (QUAILS AND PHEASANTS)

26. Gallus gallus:

Jungle Fowl.
(Domestic Fowl)

Moa.

Moa.

These semi-domesticated chickens are common on all islands where there are native villages, although the people themselves seldom eat them or their eggs; they are however freely offered to visitors and Europeans during feasts, and for barter. Both the birds and the eggs are smaller than common domestic fowl of European countries, being much inbred with various imported strains. Exceptionally wild ones are sometimes encountered in thick undergrowth of neglected coconut plantations, and these can fly considerable distances. There is no one characteristic colouring, although the roosters tend to be more uniform in colour than the hens. They are fed in the open on scraps of any food, particularly fish and grated coconut; normally no enclosure is kept especially for them by native families, but local European families invariably maintain a well-stocked 'chicken-run'. It is also locally held that they do not lay well without regular supplies of fish or crab. In most cases a whole dressed chicken is not too large

for one person's meal. Once during an inspection tour of village schools at Onotoa I was given whole chickens roasted in the native earth ovens three times in the one day! When children brought in large numbers of eggs from the nests of feral chickens in the 'bush' we tested them before bartering, as a goodly proportion would always be addled. As with other birds, the feathers are used for handicraft decorations.

IX. SYLVIIDAE (WARBLERS)

27. Conopoderas aequinoctialis. Warbler.

? Bokikokiko.

This is the bird commonly referred to as the 'Christmas Island canary'. It is probably the smallest bird in the Colony, the subspecies at Christmas being only about 5 inches in length; this is C.a. aequinoctialis. At Fanning there is a similarly coloured but definitely larger race called C.a. pistor, while at Washington Island further northwest still, there is a record of a similar bird which seems to be of a race intermediate in size to these two.

The upper parts are greyish with whitish tips to the feathers; the underparts are mostly whitish, tinged with pale grey on the sides and with pale yellow on the breast; the legs and feet are grey, and the bill blackish above, flesh colour below.

On Christmas they live chiefly among 'ren' bushes (Tournefortia); the food consists chiefly of flies and beetles caught on the branches and leaves, on the ground and in the air. Nests are made in forks of the 'ren' bushes; the nest often consists of strands of the parasitic creeper called 'te ntanini' (Cassytha) coiled around the outside and lined with leaves and grasses. It is said that two or three small eggs are laid about June; the colouring is whitish with reddish-brown spots.

Although both Kirby and King list the Gilbertese name as 'kokikokiko' I have not spoken to any Gilbertese native worker from Christmas Island who has referred to it other than 'bokikokiko'.

X. PSITTACIDAE (PARROTS)

28. Vini Kuhlui. Parakeet.

? Kura.

This very pretty bird is common on Fanning and Washington, but has not been reported from Christmas. It is about 7 inches long; the forehead

and crown are green; back of head and neck dark blue; back olive-green to yellowish-green at the tail; underparts red, with purple on the abdomen, and yellowish-green under the tail; wings greenish above, blackish below; bill and feet red.

It is said to lay two eggs in hollow places such as the tops of old coconut stumps, and, according to one oral report, it will sometimes carry its eggs away to another site if disturbed.

PART B: MIGRATORY BIRDS.

With the exception of the Long-tailed Cuckoo, all the migratory birds which visit these islands normally nest in the northern hemisphere; of these the Arctic waders of Alaska and Siberia easily form the most important group. Most of these birds leave the Colony for their northern breeding grounds about March or April and return south again, after the short Arctic summer, in September and October. Allowing for travelling time each way across some six thousand miles of ocean it is obvious that their nesting season is a comparatively short one - about June to August - and yet during this brief period they manage to prepare nests, lay and hatch the eggs, and feed the young until they are strong enough to accompany their parents on the southern migration.

Most of the migrants seen here also occur in other island territories of the north-central Pacific - Hawaii, the Marshalls and the Carolines - and some birds, such as the Turnstone and Godwit, even reach as far south as New Zealand every year, another three thousand miles on each leg of the journey. How fast do they travel? No accurate figures are available but, from records of migratory birds in Europe, the average speed for waders is 150 to 200 miles a day; here in the Pacific across certain routes in the central ocean (what Baker calls the "Nearctic-Hawaiian Flyway") there are few resting places, and probably greater average speeds are achieved. Do they ever rest on the ocean? Bailey, in "Birds of Midway and Laysan", quotes an observer who watched Golden Plovers alight on the water several times (in 1891). What percentage survives the migration? There are many unsolved

problems which can only be answered by banding and careful observations over long periods. The birds are noticeably thin on arrival in the Colony, but are correspondingly plump and often showing the brighter hues of breeding plumage before leaving for north again.

I have on occasion observed what appeared to be the arrival or departure of some of these species. The Godwits were particularly thin and pale and arrived on the lagoon mudflats in flocks of 30 to 50 birds, which immediately sat down without any preliminary strutting about! (Normally waders hardly ever sit, although they often rest on one leg.) On other occasions during the 'locally-resident' phase, this apparent state of exhaustion was never witnessed. A flock of about 200 Golden Plovers was seen to depart north from one of the old wartime airfields at Tarawa on April 4th, 1955. Many of these birds were in the darker breeding plumage and they had been observed congregating here for several days. There was much restlessness and chattering and wheeling-about for a few yards every day before they finally disappeared into the northern sky. The flying height seemed to be not much above the coconut trees, i.e. say, 100 to 200 feet.

An interesting point about the Godwits, which distinguishes their movements from those of other Arctic waders, is that they certainly pass through these islands in large numbers but only a few actually stay for the summer here. There is thus a pronounced increase in numbers on both the southern and northern journeys; their comparative scarcity between migrations probably accounts for the fact that many Gilbertese to whom I described the birds could not recollect having seen it at all! I have, however, recorded it on all islands visited in the Gilbert group. As with other species listed below, a few non-breeding birds may be seen in the Colony during the northern summer.

With the Plovers it was noticeable how a single bird or a pair seemed to occupy the same territory each season; one sensed that they were the same birds returned each year but, of course, there could be no proof of this without marking in some way. However, Gilbertese who have caught Turnstones for some of their games, and have identified their own birds by tying a piece of coloured cloth to a wing, have had the same birds return to them after an absence on migration, presumably to the Arctic and back.

I. CHARADRIIDAE (TURNSTONES AND PLOVERS)

- | | |
|--|------------------------------|
| 29. <u>Arenaria interpres interpres.</u> | Turnstone.
(Sea Dotterel) |
| Kolili. | Kitiba. |

Seen in all islands of the Colony, the Turnstone is the commonest of the Arctic visitors, and is so named because of its habit of busily overturning stones, seaweeds and tidal debris on the reef and beach in search of small crabs, shrimps, sandhoppers, and other marine creatures. Occasionally larger organisms such as the grey sand-crabs or ghost-crabs (Ocypode sp.) with carapaces up to two inches across were observed being caught and eaten. Bailey states that on Midway they feed heavily on saltbush (Scaevola)

berries. In olden days the Gilbertese used to trap Turnstones for games and bird-fighting; one of their traps consisted of an unhusked half coconut with food inside the kernel and slip-nooses of fine coconut fibre fixed vertically in the husk. Another had similar nooses set into a ring of coconut midrib which was laid on the beach with bait inside. Quite heavy stones can be lifted with their strong bills. The body is plump with a short neck and short orange legs. They are very sociable birds, usually being seen in groups of ten to 100 or more, moving about with quick short runs in a very businesslike manner. When in flight broad white bands across the upper wings and down the back are visible.

In summer plumage some of the upperparts turn reddish-brown, but the winter coat is a scheme of greys and whites. They fly north in late April and return about October. Their nests (in Arctic regions) are mere holes between tufts of moss, sometimes lined with grass or reindeer hair. Four eggs are laid in June and the young birds are ready to fly south by the end of August. The breeding range is circumpolar.

30. Pluvialis dominica fulva.

Pacific Golden Plover.

Tuli.

Kun.

The Golden Plover is also a common bird; although a few may be seen all the year round the greatest numbers are present from October to April. There is a marked difference between summer and winter plumages; in October and November when the birds arrive from the north they are noticeably thin after the long journey, and pale in colour, the underparts being almost white; by April, however, they are plump and show conspicuous black breasts with a very pale stripe over the eye and down the sides of the neck and body. The upper wings, back and tail are darkish brown mottled and edged with fawn and golden yellow. The bill is dark grey, about 1 inch long; the legs are long and slender, light bluish-grey in colour; there are only three toes.

Winter plumage: Ellice: tuli.

Gilbertese: kun au meang.

Summer plumage: tuli alo malala.

kun au maiaki.

Note: au meang: (literally: northern season) is the Gilbertese 'winter' or stormy season, about October to March, which starts when Nei Auti (the cluster of the Pleiades in the constellation Taurus) begins to show above the northern horizon at 6 o'clock in the evening, and the sun moves south of the celestial equator. Irregular storms and winds, often from the west, more frequent rain, and strong ocean currents flowing westerly characterize this season, which is the period when Arctic waders are common.

au maiaki: (lit: southern season) is the Gilbertese 'summer' or settled season, about April to September, which starts when Rimwimata (the big red star Antares in the constellation of the Scorpion) begins to show above the southern horizon at 6 o'clock in the evening, and the sun moves north of the celestial equator. Steady easterly trade winds, blue skies, little rain, and weaker ocean currents flowing easterly are typical of this season, which is also the period when Arctic waders are scarce.

The Plover is a friendly little bird, not easily frightened, and one can approach to within a few yards; on the wing it is seen to have a surprisingly long wing-span, about 18-20 inches, and is a strong flyer. Sometimes when approached it displays the curious habit of stretching its head up every now and then. Some Gilbertese have a game of asking the Plover whether it's going to rain soon, or whether the ship is near - if it stretches its head up in answer, that means 'yes'. Several different calls may be heard, common ones being like "whee-oo-wit", and "tu-li".

The food consists chiefly of small crustaceans and other tidbits found on the tidal flats or near the water's edge on the beach; often, however, birds will be found in open grassy areas or among the coconut clearings, where they can be observed eating insects and sometimes small skinks. During the heat of the day they are often more common among the coconut trees than on the beaches. There were usually twenty or more scattered over the school football field at Bikenibeu, Tarawa, always singly or in pairs. They are not at all sociable until near the departure times for migration, and one bird or a pair will defend the feeding territory, and savagely attack any intruders, even to the extent of pulling out a few feathers. They occur on all islands, including the Phoenix and Line Islands.

II. SCOLOPACIDAE (TATTLERS, CURLEWS, GODWITS)

31. Heteroscelus incanus incanus. Wandering Tattler.
Litai. Kiriri.
(Kapo; Kilikilitai;
Vivitai; Tulitainamo)

Variouslly named in different Ellice Islands, this bird has but one Gilbertese name which is adapted from its common cry when alarmed, a rippling 'ki-ree-ree', sometimes repeated once or twice. It is a very inconspicuous bird when sheltering among the rocks and dead coral along the coasts at high tide, the greys of its plumage harmonising exceedingly well with its surroundings. However, as its English name "Tattler" suggests, it is easily frightened and takes to flight uttering the characteristic warning cry at a shrill pitch and thereby setting other birds on the alert.

The bird is dark grey above and has soft bluish-grey wavy lines on a pale grey or whitish background on the underparts; the bill is fairly long, straight and dark grey, while the legs are dull yellow. There is a conspicuous light superciliary streak and a dark grey eye streak from the base of the bill.

It generally feeds alone on the edge of the tide or on mud flats but often wades out into shallow water in search of food; at high tide larger groups rest together among the rocks or in the shade of mangrove bushes. On one occasion a Tattler was observed perching on a high coconut frond, and when frightened off it flew back to another coconut tree.

In the Ellice the cry of the Tattler in the evening is regarded by the tautai (fishing-captains) as a good omen for the catching of bonito (Euthynnus yaito) the next day. Tattlers are well-known on all islands; they leave about April for the northern breeding grounds, where they nest on gravel bars in Alaska; the eggs are so well camouflaged that only two nests have been found, one in 1923 and another in 1939.

32. Heteroscelus incanus brevipes. Grey-tailed Tattler.
(Asiatic Tattler)

No distinct vernacular names exist for this closely related race, which appears to be but an occasional visitor to these islands. The two are barely distinguishable in winter plumage in the field. The upper-parts tend to be slightly lighter grey, and not so uniform in colour; also the nasal groove is somewhat shorter, and the wingspan slightly smaller. In breeding plumage the barring on the underparts is less pronounced and does not cover the lower belly and under tail-coverts. They appear to have similar habits to H.i. incanus, except that the call is different, being a kind of "ki-leep", very shrilly and repeated several times, the second note being higher in pitch. These were closely observed only at Tarawa, but may occur elsewhere.

33. Numenius tahitiensis. Bristle-thighed Curlew.
Founga. Kewe.
(Kove)

Largest of the migratory waders, this handsome bird is easily recognised not only by its size but also by the very long curved bill and haunting cry from which its Gilbertese name is derived. (The listing of the Whimbrel, N. phaeopus variegatus by Moul at Onotoa appears to be a mis-identification; it is possible that an occasional Whimbrel will be seen in the Colony, although not recorded by the present writer as no birds were shot for specimens; they are somewhat similar to Curlews in the field; the Curlew, however, may be distinguished by its characteristic cry, much longer bill, bolder colouring with more rufous tinges, darker axillaries and slightly larger size - I have confirmed all these features from observations as close as 15 yards, with careful stalking as the birds are wary and easily frightened.)

Occasional birds may be seen on all islands at any time of the year but are most common from about late August to April or May when they leave again for their breeding grounds in Western Alaska; the first nests were not discovered till 1948 - they are mere hollows in the tundra moss; four eggs are usually laid, dull greenish-buff in ground colour with grey and brown markings.

Adults have the upperparts speckled with light and dark browns; the underparts are pale buff, almost white under the tail; the plumage has a distinct rufous tinge, and in summer breeding dress the males have stronger reddish-brown on the neck and breast. There is a pale line along the mid-crown and another above each eye, and a dark brown line through each eye,

so that the head has a very striped appearance; the bill is pinkish at the base fading to grey towards the tip, curved strongly downwards and 4-5 inches long; the legs are long, steely blue-grey in colour, and there is a short hind toe.

Curlews hunt for food singly or in pairs on tidal mudflats or on the reef at low tide, poking their long bills into crevices for crustaceans and worms; they also have a curious habit of breaking open shellfish and hermit crabs by swinging them around (always clockwise viewed from behind) and dashing them open on a rock. Solitary birds are occasionally seen inland where they feed on insects and Scaevola berries, and also on the skinks of which the Plovers are so fond. On some Pacific islands Curlews have been observed stealing and eating freshly laid eggs of terns and other seabirds. For drinking seawater the bill was placed sideways in a pool, lifted out and held above the head for a few seconds, the operation being repeated several times. On the other hand Godwits lower the head and bill directly down horizontally into the water and lift up again with a slight scooping action. No doubt these two actions are governed by the characteristic shapes of the bills.

The haunting cry, something like "kiu-vee", carries far across the mudflats, and is frequently heard during flight. At high tide the birds are quiet and wary, and take shelter in small groups of six or so on a dry rocky or gravelly spit, often under the cover of shrubs, and never in the edge of the tide like some other species. They roost occasionally on the lowest branches of mangroves.

34. Limosa lapponica baueri.

Pacific Godwit.

(Eastern Bar-tailed Godwit)

Kaka.
(Kotau)

Kaka.

Slightly smaller in size than the Curlew, the Godwit is more greyish in plumage colour and may be easily distinguished by its long, almost straight (slightly upcurved) bill, which is longer in males. When birds arrive in the Colony about mid-October they are thin and pale-coloured in their winter plumage; after a few months' plentiful supply of food, however, they are plump birds by March or April when they leave again for the north; some males have by this time a handsome breast of reddish-brown for the breeding season.

The Godwit is seen chiefly on tidal mudflats, singly or in small groups; at high tide larger flocks of up to 50 birds may be found gathered on a dry spit or islet. Its food consists of tiny shellfish, other crustaceans and marine worms; it is amusing to watch a Godwit poke its bill down a hole in the mud and then run around its bill trying to locate the direction of the prey in the hole. On one occasion a Godwit passed along the ocean beach within five yards of where I was sitting; it was feeding on the small ghost-crabs which it dug out of their burrows in the sand, with the tide ebbing, and at intervals running down to the edge of the sea to wash its bill and have a short drink. On another similar occasion a Godwit was attended closely by two Turnstones which tripped in smartly under the

Godwit's head and stole the prey when opportunity offered. By the end of November and until about the end of February they are comparatively uncommon, having presumably gone further south, and many local inhabitants have not realized their presence at all, although thousands must pass through the Colony on migration.

Godwits are fairly common in the Gilbert and Ellice groups but have not been reported from the Phoenix or Line Islands, although several observers have been in those places when Godwits would be seen if present. The writer visited the inhabited islands (Canton, Sydney, Hull and Gardner) of the Phoenix group in October, 1953, but did not record any Godwits. It seems likely, however, that a few stragglers may touch on the Phoenix group, but probably not the Line Islands which are 700 miles farther east. Stickney's map showing the probable eastern limits of the wintering range includes the Phoenix group without, however, any observational evidence. Baker records that the Godwit reaches Australasia by migrating to a great extent along the edge of the Asiatic continent, and that it probably reaches eastern Micronesia as an uncommon visitor, since it is occasionally recorded in the Hawaiian Islands. However, evidence assembled in 1954 by Stidolph indicates that the main migration route to and from New Zealand is further to the east than has hitherto been supposed ("well to the eastward of the Solomons"); my own observations in the Gilbert and Ellice Islands would add support to this view.

Their nests have been found in Eastern Siberia and Alaska; they are shallow depressions in the marshy ground, lined with reindeer moss and grass. Four mottled eggs are laid about June, and by August or earlier the young birds are ready to make the long journey south, some the nine thousand miles to New Zealand.

35. Erolia ruficollis ruficollis.

Red-necked Stint.
(Eastern Little Stint)

Manu ote afa.

Nikunikun.
(Raurau; Buatua)

This is the smallest wader recorded by the writer in the Colony, being only 6 inches or less in length and of correspondingly slight build. Its neck is very short and, during the quick darting feeding movements characteristic of the species, the head seems to be bobbing continuously in search of prey. Groups of up to 22 were observed on reefs or mudflats at low tide, often mingled with and partly concealed by larger groups of Turnstones. The rufous shades of the breeding plumages are often more noticeable than the greys of the winter dress.

One or two birds which were otherwise indistinguishable from the above at a distance but which had yellowish (instead of grey or black) legs may have been the Least Sandpiper, Erolia minuta.

36. Erolia acuminata.

Sharp-tailed Sandpiper.
(Siberian Pectoral Sandpiper)

?

?

As with many other species of uncommon visitors, there appear to be no distinct vernacular names for this Sandpiper. Somewhat less common than the Stint, but not exactly rare (on Tarawa at least), this bird is fairly easy to approach within five yards or so. The slender body, rufous-brown crown, buff margins on brownish upperparts, greyish-fawn breast, white belly, dull olive-green legs and slender black bill were field characteristics easily distinguished through binoculars at this range. In flight whitish underwings with greyish edges and white axillaries were visible; there is also a pale inconspicuous upper wing-bar. On flying off the call was a quick "twee-twee-twee" or "chwee-chwee-chwee".

On several occasions groups of up to 34 in number were watched feeding on the soft red algal mud bordering brackish pools; another frequented habitat was the dry sparsely-grassed area of the school sports field at Bikenibeu, Tarawa, from which the birds appeared to be obtaining small insects. The Golden Plovers which considered this area their private territory often chased the Sandpipers off, even to the extent of pecking out a few feathers.

The only other record in the Colony is of 4 specimens collected by the Whitney Expedition at Canton on March 14th, 1924.

37. Crocethia alba.

Sanderling.

The observed rarity of this attractive little wader in these islands is in agreement with Stickney's earlier report (1943) based on collections from the Whitney Expedition. Only two individual birds were observed by the present writer in three years. Both of these were at Tarawa, on November 8 and December 17. King observed one at Christmas Island on November 7; the Whitney Expedition included one male from Canton on March 12 and one female from Sydney Island on March 21.

One of the birds I observed was feeding on the reef at low tide among Turnstones while the other was alone on a sandy lagoon beach feeding at the edge of the tide and running busily back and forth with each wave; no calls were heard.

The Sanderling is slightly larger (about 8 inches) and more plump than the Stint. In winter plumage its very pale greyish upperparts, white face and white underparts, shortish black legs and black bill make it fairly easy to identify; it is the palest overall of the waders seen. A rather prominent broad pale median wing-stripe is visible in flight.

It appears that the Sanderling is an uncommon visitor over the whole Colony from October to March. Since its wintering range is world-wide it is puzzling that it is not seen in greater numbers.

III. CUCULIDAE (CUCKOOS)

38. Urodynamis taitensis.

Long-tailed New Zealand Cuckoo.

Kaleva.
(Suvii)

Kabanei.

About the time (August-September) when the first Arctic visitors are beginning to arrive the Cuckoo sets off on a long southern journey to spend the late spring and summer in New Zealand where it breeds. The earliest date of its return which the writer noted at Tarawa was March 20th. According to a Gilbertese legend this bird lays not on the ground or in trees but flies so high into the sky and the egg takes so long to fall that the youngster has hatched and is able to fly on reaching the ground again. A similar belief was held about the nesting of some other migratory birds such as the Curlew. The Marshallese have similar legends to account for reproduction among their bird migrants.

Another saying of the Gilbertese, especially in the southern islands of the drought belt, is that when the harsh cry of the cuckoo is heard in the bush, rain is not far off. In the Phoenix the bird is more rare and there is a belief that if the cuckoo's cry is heard above a house one of the occupants will be stricken with severe stomach pains.

The Cuckoo is a bird of the forest and only brief glimpses of it are obtained during its straight and swift flight from one palm-top to another, or perhaps for longer periods during feeding. One of its favourite habitats is among the open flower-spikes of the coconut palm or near the sap-collecting gourds' ("toddy-shells") around which there are plenty of flies, ants, and other insects which form its main diet. The bird is easily recognised by its hawk-like appearance, long tail, and by the characteristic harsh repeated whistle. This cry is heard at night as well as during the day but the exact location of the originator is often difficult to pinpoint.

According to Baker the northern limit of its migratory range is in the Carolines and Marshalls, being more common in the latter group. This distribution seems to be in agreement with observations for this Colony, where it is more common in the Ellice than in the Gilberts, rather uncommon in the plantation islands of the Phoenix (Sydney, Hull, Gardner), and appears to be unknown on the other (almost treeless) islands of the Phoenix, including Canton. There have been no authentic reports from the Line Islands; one Gilbertese native informant told me a few visited Christmas and Fanning. Its greater numbers in the Ellice, which lie within a heavier rain belt, may be partly due to the more dense bush there, affording more cover and probably greater food supplies. Its main winter range is eastern and central Polynesia, and Fiji.

IV ANATIDAE (DUCKS)

It appears that at least three species of migratory ducks from the New World visit islands as far south as the Ellice group quite regularly,

though not in large numbers at any one time. Unidentified ducks visiting Fanning (Kirby, 1925 and King, 1954) during the northern autumn were probably of one or more of these three species. Since the places they frequent on the atolls are usually rather secluded it is difficult to assess their numbers, distribution and seasons (if any). They are seen on freshwater ponds, brackish inland pools and on the stagnant water or in the vicinity of the sunken garden pits in which "babai" (Cyrtosperma chamissonis) is cultivated. Apparently they have not been hunted for food by the native peoples and, although they seem to be known on all islands, no distinction is given in vernacular names to the two species which I have seen. Since ducks are very adaptable in feeding and breeding habits there is the possibility of nesting occurring in the Colony. Sharpe and Whitmee (1878) obtained 3 eggs of a duck in the Ellice but no other details were given. Bailey quotes a man at Canton who reported seeing a nest with eggs of the Mallard in June, 1953.

39. Anas acuta tzitzihoa. Pintail.

?

?

Tristram reported a species of Pintail (Dafila modesta) from Sydney Island in 1886. This appears to be the same species as the present Anas acuta. King sighted one or two of these occasionally on ponds near the airfield at Christmas Island (1954), and a flock of 20 thought to be Pintails flying in off the ocean from the northeast on November 18.

It has not been reported from the Gilbert and Ellice groups, and was not sighted there by the present writer.

40. Anas platyrhynchos platyrhynchos. Mallard.

Toloa.

Tiriwenei.

A female of this species was brought in to me from a babai pit at Tarawa on 16th October. It appeared to be rather weak and in poor condition but not injured in any way. Other single birds and pairs were seen at various islands in both the Gilbert and Ellice groups from September to December. From the few observations made and from the reports of other writers this seems to be the main arrival period, and April to June the departure time, although some may remain in this area the whole year round.

41. Spatula clypeata. Shoveller.

Toloa.

Tiriwenei.

These ducks also seem to be regular but not common visitors to all islands. Two drakes in full colour were seen on 2nd April on freshwater ponds near the old airstrip at Bonriki, Tarawa. They were not easily approached but, after taking to the air several times, always returned to the same stretch of water. Ducks of this species have been observed at Canton and other islands of the Phoenix group.

APPENDIX A: PROTECTED BIRDS:

The following birds are protected under the Wild Birds Protection Ordinance of 13th October, 1921.

- (i) Birds protected the whole year:
 White Tern, Black-naped Tern, Crested Tern, Brown-winged Tern.
 Brown Noddy, Black Noddy, Blue-grey Noddy.
 Blue-faced Booby.
 Greater Frigate-Bird.
 Red-tailed Tropic-Bird, White-tailed Tropic-Bird.
 Dusky Shearwater.
 Reef Heron.
- (ii) Birds protected part of the year:
- | | |
|-------------------------|------------------------|
| Brown Booby: | December to April. |
| Turnstone: | September to February |
| Pacific Golden Plover: | September to February. |
| Bristle-thighed Curlew: | November to August. |
| Pacific Godwit: | September to February. |

APPENDIX B: SOME COMMON TREES ASSOCIATED WITH BIRDS:

		<u>Gilbertese:</u>	<u>Ellice:</u>
Cocos nucifera	Coconut palm	Ni	Niu
Pandanus tectorius	Pandanus	Kaina	Fala
Scaevola sericea	Salthush	Mao	Ngasu
Tournefortia argentea	Umbrella-tree	Ren	Tausumu
Cordia subcordata	—	Kanawa	Kanava
Pisonia grandis	—	Buka	Puka
Guettarda speciosa	—	Uri	Pua
Pemphis acifula	Ironwood	Ngea	Ngie
Calophyllum inophyllum	Tamanu-tree	Itai	Fetau
Artocarpus spp.	Breadfruit	Mai	Matalafi (?)
Rhizophora mucronata	Mangrove	Tongo	?
Morinda citrifolia	Malay Custard-apple	Non	Nonu
Ficus tinctoria	Fig	Bero	Felo

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